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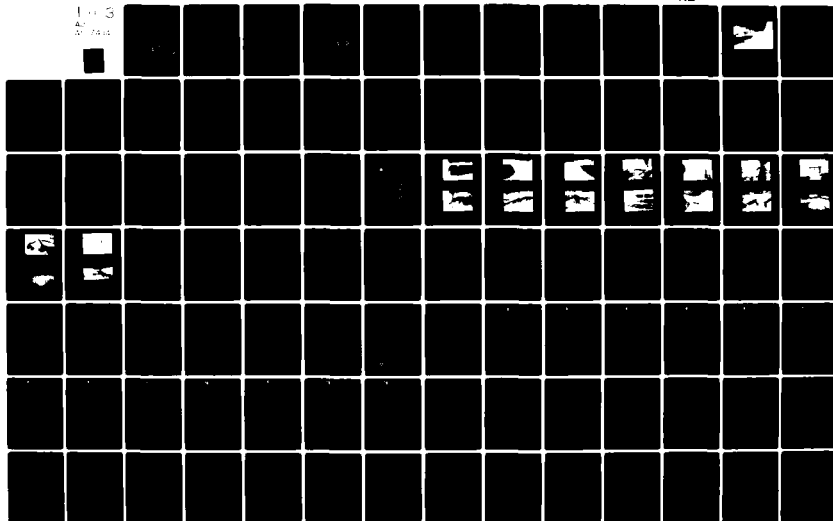
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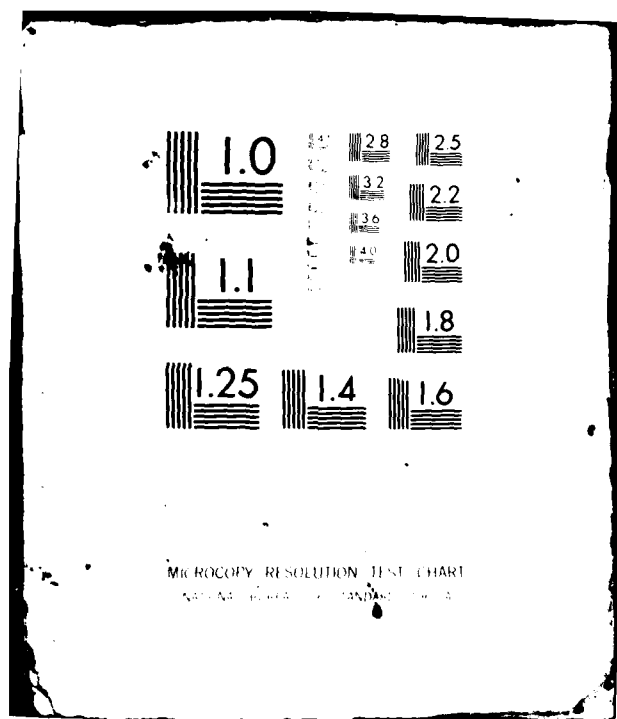
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SUSQUEHANNA RIVER BASIN

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## NORWICH RESERVOIR NO. 2 DAM

CHENANGO COUNTY, NEW YORK  
INVENTORY No. NY 349

# PHASE I INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  This report provides information and analysis on the physical condition of the dam as of the report date. Information and analysis are based on visual inspection of the dam by the performing organization.  Examination of available documents and a visual inspection of the dam did not reveal conditions which constitute an immediate hazard to human life or property. However, the dam has some deficiencies that need to be evaluated and remedied.		

Using the Corps of Engineers' Screening Criteria for the initial review of spillway adequacy, it has been determined that the embankment would be overtopped by the outflow resulting from all storms exceeding 13 percent of the Probable Maximum Flood (PMF). Dam overtopping, the resulting erosion of the embankment and hence, dam breaching would cause water surface levels downstream to reach depths which would pose significant danger to residents. Therefore, the spillway is adjudged to be seriously inadequate and the dam is assessed as unsafe, nonemergency.

The classification "unsafe" applied to a dam because of a seriously inadequate spillway is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. It does mean that there appears to be a serious deficiency in spillway capacity and if a severe storm were to occur, overtopping and failure of the dam could take place, significantly increasing the hazard to life downstream from the dam.

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## PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM  
NORWICH RESERVOIR NO. 2 DAM  
INVENTORY NO. NY 349  
SUSQUEHANNA RIVER BASIN  
CHENANGO COUNTY, NEW YORK

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PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM

Name of Dam:               Norwich Reservoir No. 2 Dam  
State Located:            New York  
County:                   Chenango  
Watershed:                Susquehanna River Basin  
Stream:                   Ransford Creek  
Date of Inspection:   March 13, 1981

ASSESSMENT

Examination of available documents and a visual inspection of the dam did not reveal conditions which constitute an immediate hazard to human life or property. However, the dam has some deficiencies that need to be evaluated and remedied.

Using the Corps of Engineers' screening criteria for the initial review of spillway adequacy, it has been determined that the embankment would be overtopped by the outflow resulting from all storms exceeding 13 percent of the Probable Maximum Flood (PMF). Dam overtopping, the resulting erosion of the embankment and hence, dam breaching would cause water surface levels downstream to reach depths which would pose significant danger to residents. Therefore, the spillway is adjudged to be seriously inadequate and the dam is assessed as unsafe, nonemergency.

The classification "unsafe" applied to a dam because of a seriously inadequate spillway is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. It does mean that there appears to be a serious deficiency in spillway capacity and if a severe storm were to occur, overtopping and failure of the dam could take place, significantly increasing the hazard to life downstream from the dam.

It is recommended that the following additional investigations be performed by a registered professional engineer engaged by the owner:

1. Conduct a detailed hydrologic and hydraulic analysis to determine the need for and methods of increasing the discharge capacity of the dam. This would include investigating the adequacy of the principal spillway weir and discharge channel (bypass canal) and the emergency spillway.

2. Verify the location, methods of construction and if possible, the condition of the outlet modifications (where the 36 inch former principal spillway was cut off and flow was diverted to the twin 12 inch pipes leading to the lower reservoir).

It is recommended that within 3 months of the final approval date of this report, the hydrologic investigation of the structure should be undertaken and within 6 months, the remaining investigation should commence. Appropriate remedial measures for both additional investigations should be completed within 18 months of the final approval.

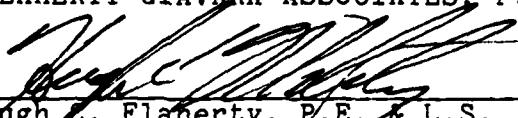
The following remedial measures should be completed within 12 months to correct existing deficiencies:

1. Remove all spruce trees that are growing between the crest and lower berm on the left side of the downstream embankment slope and also any whose trunks or roots may be encroaching onto the right side of the embankment. The trees growing on the abutments may remain. The trees to be removed constitute a potential hazard if uprooted during a storm. This may lead to a loss of freeboard, to a dangerous reduction of embankment width, or to the formation of piping channels if uprooted and the remaining roots rot in place.
2. The trunks of all cut trees are to be removed and backfilled. Equipment and procedures for this maintenance operation should be such as to avoid damage to existing grass and weed cover on the slopes. Any slopes that become scarred by runoff or traffic should be reseeded and mulched.
3. Patch the cracks in the concrete apron and repair the separation between the concrete headwall and apron of the emergency spillway inlet to prevent water from flowing up from beneath the apron.
4. Place rockfill in the bypass canal below the outlet headwall of the emergency spillway where undermining has begun.
5. Ensure the reservoir drain and its controls are operational.
6. Backfill and regrade the areas of minor surface sloughs on the downstream slope.
7. Regrade the dam crest to remove vehicle ruts and shallow depressions and allow surface runoff without concentrated flow. A gravel surface layer would improve trafficability and reduce rutting.
8. Continue to periodically cut the brush on the slopes of the embankment and the bypass canal bottom to prevent their being overgrown.

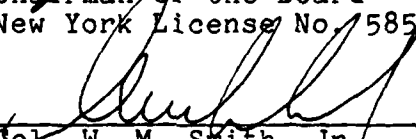
9. Fill in the animal burrows noted on the embankment slopes.
10. Develop and implement a flood warning and emergency evacuation plan to alert the downstream residents in the event conditions occur which could result in failure of the dam.

Submitted by:

FLAHERTY GIAVARA ASSOCIATES, P.C.

  
\_\_\_\_\_  
Hugh C. Flaherty, P.E. & L.S.  
Chairman of the Board  
New York License No. 58508

Approved by:

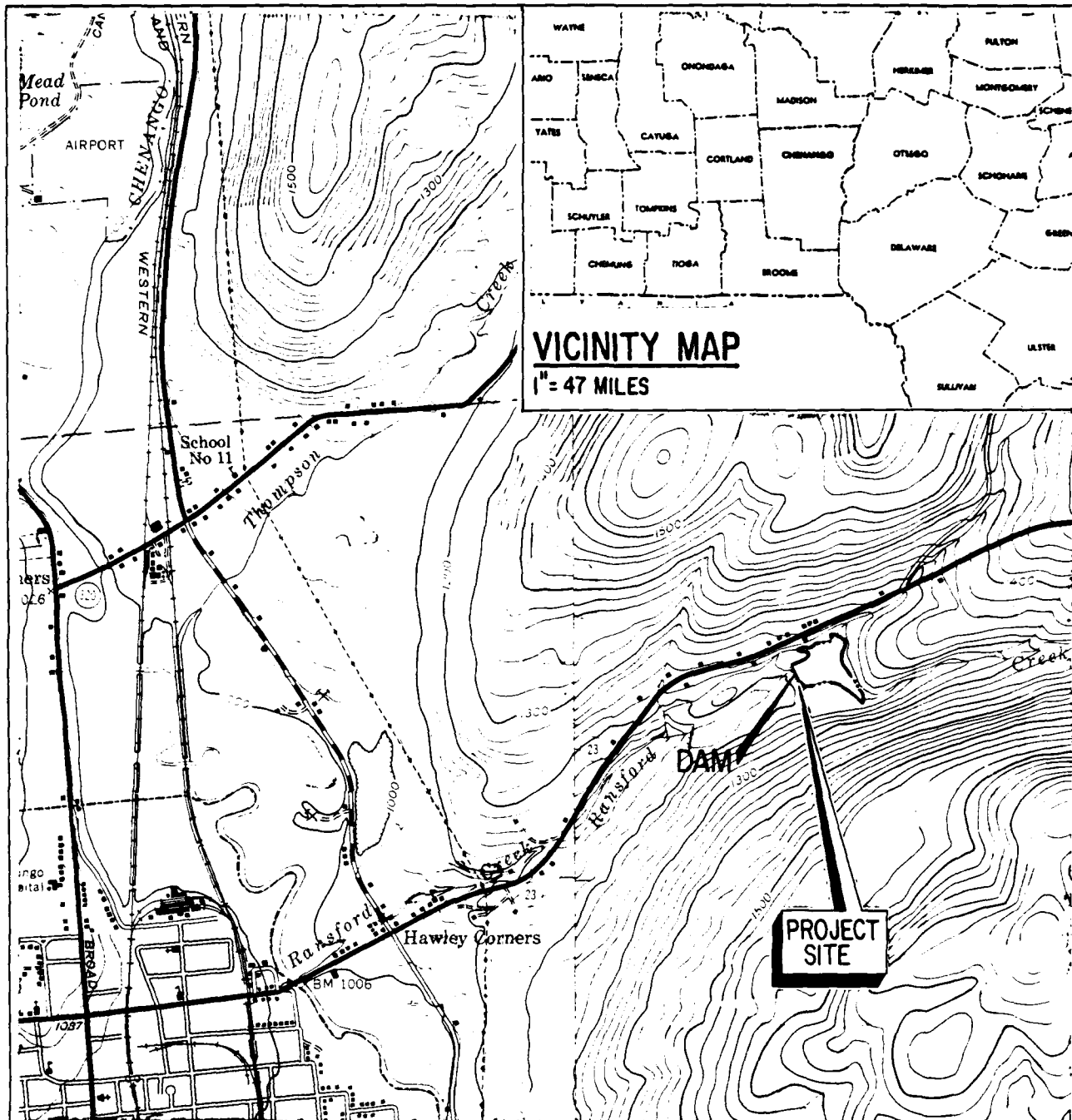
  
\_\_\_\_\_  
Col. W. M. Smith, Jr.  
New York District Engineer

Date:

3 Aug 8



PHOTO #1: Overview of  
Norwich Reservoir No. 2 Dam  
Inventory No. NY 349



## LOCATION MAP

**NORWICH RESERVOIR No. 2 DAM  
INVENTORY No. NY 349**

**SUSQUEHANNA RIVER BASIN  
CHENANGO COUNTY  
NORWICH, NEW YORK**



0 2000 4000  
SCALE IN FEET

FLAHERTY • GIAVARA ASSOCIATES, P.C.

NATIONAL DAM SAFETY PROGRAM  
PHASE I INSPECTION REPORT  
NORWICH RESERVOIR NO. 2 DAM  
INVENTORY NO. NY 349  
D.E.C. NO. 117C-621  
SUSQUEHANNA RIVER BASIN  
CHENANGO COUNTY, NEW YORK

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

The Phase I Inspection reported herein was authorized by the Department of the Army, New York District, Corps of Engineers, to fulfill the requirements of the National Dam Inspection Act, Public Law 92-367. Flaherty Giavara Associates, P.C. has been retained by the New York District to inspect and report on selected dams in the State of New York. Authorization and notice to proceed was issued to Flaherty Giavara Associates, P.C. under a letter of December 24, 1980 from W. M. Smith, Jr. Colonel, Corps of Engineers. Contract No. DACW 51-81-C-0006 has been assigned by the Corps of Engineers for this work.

b. Purpose

Evaluation of the existing conditions of the subject dam to identify deficiencies and hazardous conditions, determine if they constitute hazards to life and property and recommend remedial measures where necessary.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

Norwich Reservoir No. 2 Dam consists of an earthen embankment with a 36 inch diameter cast iron water supply pipe under the right central portion of the embankment, a cut stone masonry and concrete principal spillway with flashboards and a "bypass canal" beyond the right abutment and an emergency spillway utilizing twin 48 inch diameter corrugated metal pipes through the right abutment. Profiles and sections prepared for the project by the Norwich Water Works are included on drawings in Appendix F.

The dam embankment is 638 feet long and a maximum of 56 feet high and has an upstream slope of 3 horizontal to 1 vertical and a downstream slope of 2 to 1. The crest of

the dam is 10 feet in width and its elevation is 1249.0 (NGVD). There is a 15 to 18 foot berm near the downstream toe of slope. The embankment cross section consists primarily of compacted glacial material except for a 10+ foot wide zone of compacted clay and gravel (puddled) core. The core is 5 feet wide near the top of the embankment and widens to 9 to 14 feet at the original ground surface. The core extends 7 to 18 feet below ground surface to form a cutoff. The width of the bottom of the cutoff is approximately 5 to 6 feet.

The upstream slope has a layer of 15 inches of broken rock for slope protection, while the downstream slope has a "soil dressing" and grass.

A 36 inch diameter cast iron water supply pipe runs beneath the right central part of the embankment from an intake structure in the reservoir, and constitutes part of the water supply system for the City of Norwich.

The principal spillway is 45 feet wide consisting of a cut stone masonry and concrete weir with wooden flashboards, cut stone masonry abutments and wingwalls and a 2400 foot long "bypass canal". It is located to the north of the right abutment diverting flow around both this dam and Norwich Water Works Dam No. 1 (NY 347). The "bypass canal" is excavated into earth and rock while portions of the left side are formed by a berm. The excavated side slopes vary; however, the berm side slopes are 2 horizontal to 1 vertical on the canal side and 2.5 to 1 on the side sloping away from the canal.

The emergency spillway consists of two 48 inch diameter corrugated metal pipes located between the reservoir and the bypass canal and discharging a short distance downstream of the principal spillway weir. At the inlet, there is a concrete headwall and a concrete apron which serves as a weir, and at the outlet into the bypass canal there is a concrete endwall.

b. Location

The Norwich Reservoir No. 2 Dam is located off New York Route 23 approximately 1.6 miles northeast of the City of Norwich in the Town of Norwich, New York. The dam is located at latitude north 42°-33.0' and longitude west 75°-29.3' on the U.S. Geological Survey 7.5 minute series topographic map "Holmesville, New York". The Location Map on page i indicates where the dam is situated.



c. Size Classification

The maximum height of the dam is 56 feet and the maximum storage capacity is 222 acre-feet. Therefore, Norwich Reservoir No. 2 Dam is classified as an "Intermediate" dam as defined by the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification

There are approximately 2 dwellings, a large trailer park (30 to 40 trailers), 4 commercial buildings, two major roads (including New York Route 23) and high voltage transmission lines within the dam failure flood hazard area. Therefore, the dam is in the "High" hazard category as defined by the Recommended Guidelines for Safety Inspection of Dams.

e. Ownership

The dam is owned by the City of Norwich. The address and telephone number of the owner is as follows:

Owner

Contact: Mr. Nicholas W. Andrews, Superintendent  
Norwich Water Department  
City of Norwich  
31 East Main Street  
Norwich, New York 13815

Telephone: (607) 334-6618

f. Purpose

The primary purpose of this dam is water supply for the City of Norwich.

g. Design and Construction History

The dam was designed in 1888 by the Norwich Water Works, W. S. Franklin, Chief Engineer and John Mitchell, President. It was constructed in 1890 by the Troy Public Works Company-Limited of Troy, New York. Major post construction modifications include the installation of flashboards on the principal spillway weir in 1913 and the construction of the emergency spillway in 1967.

h. Normal Operating Procedure

The water level in the reservoir is checked visually twice daily, seven days a week. The flashboards are lowered in late spring to retain flow during the dry months,

then they are raised in late fall to permit flow to pass during the wet months.

1.3 PERTINENT DATA

a.	<u>Drainage Area (Square Miles)</u>	3.79
b.	<u>Discharge at Dam Site (CFS)</u>	
	- Top of Dam	934
	- Crest of Emergency Spillway	95
	- Crest of Principal Spillway	
	left weir (with flashboards)	69
	right weir (without flashboards)	-
c.	<u>Elevations</u>	
	- Top of Dam	1249.0
	- Crest of Emergency Spillway	1245.6
	- Crest of Principal Spillway	
	left weir (with flashboards)	1245.4
	right weir (without flashboards)	1244.1
	- Reservoir Drain Inlet	1205.0
d.	<u>Reservoir Surface Area (Acres)</u>	
	- Top of Dam	12.0
	- Crest of Emergency Spillway	10.0
	- Crest of Principal Spillway	
	left weir (with flashboards)	9.9
	right weir (without flashboards)	9.1
e.	<u>Storage (Acre-Feet)</u>	
	- Top of Dam	222
	- Crest of Emergency Spillway	189
	- Crest of Principal Spillway	
	left weir (with flashboards)	187
	right weir (without flashboards)	176
f.	<u>Dam</u>	
	- Type: Compacted glacial material with a compacted clay and gravel (puddled) core and cutoff	
	- Length (Feet)	638
	- Upstream Slope (H:V)	3:1
	- Downstream Slope (H:V)	2:1
	- Crest Width (Feet)	10

g. Principal Spillway

- Type: Cut stone masonry weir with a concrete crest and adjustable flashboards as well as an excavated earthen channel (bypass canal)
- Length (Feet)
  - weir 42
  - channel 2400
- Bottom Width (Feet)
  - weir 30
  - channel 45
- Side Slopes (H:V)
  - weir vertical
  - channel 0.5-2.0:1
- Channel Bottom Slopes (Feet/Foot)
  - upstream -
  - downstream 0.004 to 0.060
- Control: Flashboards

h. Emergency Spillway

- Type: Twin 48 inch diameter corrugated metal pipes (112 feet long) with a concrete apron and headwall at its inlet and a concrete endwall at its outlet
- Control: None

i. Reservoir Drain

- Type: 36 inch diameter cast iron pipe (200 feet long)
- Control: 36 inch diameter slide gate located near the outlet into the stilling basin

## SECTION 2 - ENGINEERING DATA

### 2.1 GEOTECHNICAL DATA

#### a. Geology

The Norwich Reservoir No. 2 Dam is located on Ransford Creek, a southwesterly flowing tributary to the Chenango River, about 1.5 miles northeast of the City of Norwich in the Appalachian (Allegheny) Plateau physiographic province of New York State.

The topography in the area ranges from elevation 1200 at the streambed downstream of the dam to about elevation 1500 to 1780 at the summits of hills surrounding the dam and reservoir area.

The underlying bedrock at the site consists of the Unadilla Formation belonging to the Upper Devonian Genesee group. This formation consists of coarse silty shales and siltstones that were deposited in a shallow water, near-shore setting of the Catskill Delta that propagated across the state from east to west. The bedding of these deposits is quite even and laminated, splitting readily into thin sheets upon exposure.

Above the bedrock, the valley bottom and side slopes are mantled by a heterogeneous mixture of clay, silt, sand and rock fragments known as glacial till (or hardpan).

#### b. Subsurface Investigations

No known subsurface explorations were made at the site. Based on reports made in the mid 1920's, the subsurface conditions at the site consist of relatively impermeable glacial till (hardpan) or shale bedrock.

### 2.2 DESIGN RECORDS

The Norwich Reservoir No. 2 Dam was designed in 1888 by the Norwich Water Works, W. S. Franklin, Chief Engineer. No design data was obtained for this dam.

### 2.3 CONSTRUCTION RECORDS

This dam was constructed in 1890 by the Troy Public Works Company-Limited of Troy, New York. Cross sections and a profile of the embankment and bypass canal, a plan and profile of the waste weir and plans for the installation of the flashboards are included in Appendix F. In addition, excerpts from the technical specifications can be found in Appendix D.

#### 2.4 OPERATION RECORDS

There were no operation records available for this dam.

#### 2.5 EVALUATION OF DATA

The data presented herein was obtained primarily from the Norwich Water Department located in Norwich, New York and also from the files of the New York State Department of Environmental Conservation (DEC). This information appears to be reliable and adequate for the purposes of a Phase I Inspection Report.

## SECTION 3 - VISUAL INSPECTION

### 3.1 FINDINGS

#### a. General

Visual inspection of the Norwich Reservoir No. 2 Dam was conducted on March 13, 1981. The weather was overcast and the temperature was 40+°F. At the time of the inspection, there were small patches of snow on the ground and water was flowing in the principal spillway (See Photo No. 9).

#### b. Dam

The earthfill embankment of the dam is generally in good condition (See Photos No. 4, 5, 6 and 7). The dam crest is also in good condition except for vehicle ruts and shallow depressions and is presently used for access to Norwich Water Works Dam No. 1 (See Photo No. 3). There was no visible evidence of lateral movement, seepage, major settlement or erosion, or other serious defects.

The following specific items were noted:

1. Several minor surface sloughs were observed on the right side of the upper downstream slope.
2. Several large animal burrows were noted on the upper portion of the downstream slope. Several small animal burrows were observed near the crest on both the upstream and downstream slopes (See Photo No. 18).
3. Moderate to large-sized spruce trees are growing on the downstream slope along the left and right abutments; this tree cover overlaps onto the downstream embankment slope on the left side (See Photos No. 5 and 7).

#### c. Principal Spillway

##### 1. Principal Spillway Weir

This two-stage broad-crested weir is constructed of cut stone masonry and concrete and is in good condition. The lower stage contains provisions for 2.5 foot high adjustable flashboards. The approach channel to the weir is straight, free from debris and also in good condition (See Photo No. 8). A 50 foot long by 13 foot wide bridge spans the spillway weir (See Photo No. 8) and is used for access to the lower reservoir, dam and chemical feed building. It has two spans constructed of steel I-beams, a steel grate

deck and a 3 foot high pipe rail parapet (See Photo No. 8).

2. Principal Spillway Discharge Channel (Bypass Canal)

The discharge channel has a typical width of 45 feet, a length of approximately 2400 feet and is in good condition (See Photo No. 12). This channel directs flow around both this dam and the lower dam (NY 347). The side slopes of the channel vary from 0.5 horizontal to 1 vertical to 2:1 and are excavated into bedrock in some sections. Portions of the left side slope are formed by an earthen berm.

d. Emergency Spillway

The twin 48 inch diameter corrugated metal pipes which discharge into the bypass canal are in good condition showing little sign of deterioration.

The following observations were made:

1. Numerous cracks were observed in the concrete walls and apron of the inlet structure (See Photo No. 10). These cracks range from hairline to 1/4 inch in width and at one location as indicated on the sketch on page B-11 in Appendix B, there is a 3/8 inch separation between the abutment and wingwall. Water seepage was noted between the concrete apron and the headwall at the inlet (See Photo No. 11). The pipe inlet elevation was approximately 0.3 feet below the reservoir level at the time of observation.
2. Slight undermining of the concrete endwall was noted at the emergency spillway outlet into the bypass canal (See Photos No. 12 and 13). No flow beneath the headwall was observed.
3. The left 48 inch CMP has an angle point in its horizontal alignment.

e. Water Distribution System Appurtenances

1. Intake Structure

A wood and stone masonry intake structure is located approximately 100 feet from the dam crest within the reservoir (See Photo No. 14). It is connected to the shoreline by a 58 foot long by 5 foot wide access footbridge. Both structures are in good condition showing little sign of deterioration.

## 2. Outlet Works

The primary outlet works is a 36 inch diameter cast iron water supply pipe located between the intake structure and the stilling basin (See No. Photo 15). Connected to this pipe is a 12 inch diameter cast iron pipe which supplies water to two 4 inch diameter cast iron discharge pipes (See Photo No. 16), to the aerating jets of the lower reservoir and to the City of Norwich water distribution system. Additionally, a 14 inch diameter cast iron pipe serves as a drain for the stilling basin emptying into the lower reservoir (See Photo No. 17). The pipe networks for the upper and lower reservoirs are shown on a "Sketch Map" on page D-17 in Appendix D.

### f. Downstream Channel

The only natural channel downstream of the dam is located at the end of the bypass canal below the lower dam and reservoir. It has a width of 10 to 15 feet and a depth of 6 inches. Immediately downstream of the upper dam is the lower reservoir and dam - NY 347 (See Photo No. 19).

### g. Reservoir - Storage Pool Area

The reservoir area is bordered by moderately to steeply sloping wooded land. There does not appear to be any significant probability of landslides into the storage pool affecting the safety of the dam (See Photo No. 2).

The "bypass canal" for Reservoir No. 2 runs along the top of the slope above the right side of Reservoir No. 1. An earthen berm was built along portions of the bypass canal on the side adjacent to Reservoir No. 1, but well back from the top of slope.

## 3.2 EVALUATION OF OBSERVATIONS

The visual inspection revealed several deficiencies. The following observations were made:

- a. Moderate to large-sized spruce trees were growing on the left downstream slope and along each abutment.
- b. Numerous cracks were noted in the concrete walls and apron of the emergency spillway inlet structure.
- c. Slight undermining of the concrete endwall was observed at the outlet to the emergency spillway.
- d. Several minor surface sloughs were observed on the right side of the upper downstream slope.



- e. Vehicle ruts and shallow depressions were noted on the dam crest.
- f. Several large animal burrows were noted on the upper portion of the downstream slope.

## SECTION 4 - OPERATION AND MAINTENANCE PROCEDURES

### 4.1 PROCEDURES

The normal water surface level is maintained by the crest of the right broad-crested weir of the principal spillway at elevation 1244.1 (NGVD). However, with the flashboards in place, the normal water surface level is increased to the elevation of the left broad-crested weir at 1245.4 (NGVD). The following operational procedures are in effect at this time:

- a. The reservoir water level is checked visually twice daily, seven days a week.
- b. The reservoir level can be raised by diverting water via a tunnel to Ransford Creek from Chenango Lake in the Unadilla River watershed.

### 4.2 MAINTENANCE OF DAM

Maintenance operations at the Norwich Reservoir No. 2 Dam include:

- a. The dam crest and embankments are mowed manually once every year.
- b. Deciduous trees are cut back annually to prevent them from growing too close to the reservoir.
- c. Repairs to masonry are performed as required.
- d. Metalwork and wooden structures are painted as necessary.

### 4.3 WARNING SYSTEM

No warning system is presently in effect.

### 4.4 EVALUATION

Presently, the operation and maintenance procedures in effect for this dam and its appurtenances are satisfactory. However, increased maintenance efforts are required to correct the deficiencies which now exist.

## SECTION 5 - HYDROLOGIC/HYDRAULIC

### 5.1 DRAINAGE AREA CHARACTERISTICS

The dam is located in the Town of Norwich on Ransford Creek, approximately 8100 feet upstream of the Chenango River. Ransford Creek joins the Chenango River at the City of Norwich, approximately forty-five miles upstream of the Susquehanna River at Binghamton, New York.

The watershed (shown on the Watershed Map on Page C-5 in Appendix C) consists of 2424 acres (3.79 square miles) of hilly uplands. It is divided into two subwatersheds, one has typical slopes of 15+ percent while the other has slopes ranging from 5 to 10 percent. Land within the watershed is primarily agricultural with extensive open fields.

Two watercourses flow into the reservoir; each is a small perennial stream with a typical flow width of 10 feet and a typical flow depth of 6 inches.

### 5.2 ANALYSIS CRITERIA

The purpose of the hydrologic/hydraulic analysis is to evaluate the spillway capacity and the potential for overtopping. The analysis of the spillway capacity of the dam and storage of the reservoir was performed using the Corps of Engineers HEC-1 Computer Model - Dam Safety Version. The procedure included determining the Probable Maximum Flood (PMF) runoff from the watershed and routing the inflow hydrograph through the impoundment to determine the outflow hydrograph. The unit hydrograph was defined by the Snyder Synthetic Unit Hydrograph method, and the Modified Puls routing procedure was incorporated.

The initial rainfall loss was assumed to be 1.0 inches, and the uniform rainfall loss was assumed to be 0.1 inches per hour. In accordance with recommended guidelines of the Corps of Engineers, the Probable Maximum Precipitation (PMP) was 20.2 inches (24 hour duration, 200 square mile area).

The analysis was conducted for both the full PMF and for several fractional PMF conditions. The PMF inflow of 8626 CFS was routed through the reservoir and the peak outflow was determined to be 8626 CFS.

### 5.3 SPILLWAY CAPACITY

The total outlet capacity is the sum of the discharges from the principal spillway and the emergency spillway.

The principal spillway consists of a two stage broad-crested overflow weir, one stage being 16.7 feet long and the other

13.0 feet long. The right weir is at a lower elevation (1244.1 NGVD) than the left weir (1245.4 NGVD) and has 2.5 feet of adjustable flashboards.

The emergency spillway consists of a concrete apron at the inlet that acts as a weir for certain stages and two 48 inch diameter corrugated metal pipes (CMP).

The stage discharge data for the combined principal and emergency spillways was calculated for the stages tabulated below:

<u>Stage (Feet)</u>	<u>Discharge Capacity (CFS)</u>	<u>Element of Structure</u>
1244.1	0	Right Broad-Crested Weir
1244.4	6	--
1245.4	69	Left Broad-Crested Weir
1245.6	95	Emergency Spillway Crest
1246.4	263	--
1247.4	487	--
1248.4	746	--
1249.0	934	Top of Dam

The total spillway capacity at the top of the dam is 934 CFS.

The principal spillway can pass the peak outflow from a flood equal to approximately 3 percent of the PMF before use of the emergency spillway would be required.

#### 5.4 RESERVOIR CAPACITY

The storage capacity of the reservoir was obtained primarily from the records of the Norwich Water Department as indicated below:

<u>Stage (Feet)</u>	<u>Storage (Acre-Feet)</u>	<u>Storage (Inches of Runoff)</u>
1244.1	176	0.87
1245.4	187	0.93
1245.6	189	0.94
1249.0	222	1.10

### 5.5 FLOODS OF RECORD

No data regarding floods of record was obtained for this dam.

### 5.6 OVERTOPPING POTENTIAL

The results of the HEC-1 DB computer analysis indicate that the crest of the dam is overtopped by all storms exceeding 13 percent of the outflow from the PMF event. The PMF discharge rate of 8626 cubic feet per second (CFS) would occur at a peak flood stage of 1252.7 feet, which is 3.7 feet above the crest of the dam.

The results of the analysis are tabulated below:

<u>Flood Condition</u>	<u>Peak Inflow (CFS)</u>	<u>Peak Outflow (CFS)</u>	<u>Maximum Stage Elevation (NGVD)</u>
0.5 PMF	4313	4313	1251.0
1.0 PMF	8626	8626	1252.7

### 5.7 EVALUATION

Using the Corps of Engineers' screening criteria for the initial review of spillway adequacy, it has been determined that the combined capacity of the principal and emergency spillways is not adequate to pass either the full PMF or one half the PMF; only approximately 13 percent of the outflow from the PMF can be safely passed before overtopping will occur. The PMF event would overtop the dam for a duration of 13 hours and the maximum depth of flow over the crest would be 3.7 feet. It is estimated that as a result of overtopping, breaching of the dam would cause water surface levels downstream to reach depths which would pose significant danger to residents. Therefore, the spillway is adjudged to be seriously inadequate and the dam is assessed as unsafe, nonemergency.

## SECTION 6 - STRUCTURAL STABILITY

### 6.1 EVALUATION OF STRUCTURAL STABILITY

#### a. Visual Observations

There was no visible evidence of major settlement, lateral movement or other signs of overall structural instability of the dam during the site examination. Based on the conditions that were observed, there is no reason to question the static structural stability of the dam.

#### b. Design and Construction Data

The drawings entitled "Storage Reservoir Embankment, Upper Location", "Waste Weir" and "Bypass Canal" for the Norwich Reservoir No. 2 Dam (See Appendix F) show a configuration for the embankment, principal spillway and discharge channel that generally corresponds to the conditions observed on March 13, 1981, with the following exceptions:

1. The discharge is no longer through the 36 inch diameter cast iron pipe into the lower reservoir.
2. An earthen berm has been constructed at the downstream toe of the embankment.
3. Flashboards were installed on the principal spillway weir in 1913.
4. The emergency spillway was built in 1967.

There is no construction data to confirm the actual physical properties and configuration of the earthfill or the puddled core in the embankment. However, the dam proportions are considered to be reasonable for the soils that were available at the site and the dam would be expected to have adequate safety margins with respect to stability under static loading conditions.

#### c. Seismic Stability

The Norwich Reservoir No. 2 Dam is located in Seismic Zone 1, and in accordance with recommended Phase I guidelines does not require seismic analysis.

## SECTION 7 - ASSESSMENT/RECOMMENDATIONS

### 7.1 ASSESSMENT

#### a. Condition

On the basis of the visual examination, the embankment and appurtenances of the Norwich Reservoir No. 2 Dam are considered to be in good condition. There were no signs of impending structural failure or other conditions which would warrant urgent remedial action; however, a number of minor deficiencies were noted.

#### b. Adequacy of Information

The evaluation of the embankment portions of this dam is based primarily on visual examination, reference to available plans, approximate hydraulic and hydrologic computations, and application of engineering judgement. The available information that was obtained is adequate for the purposes of a Phase I assessment.

#### c. Need for Additional Investigations

It is recommended that the following additional investigations be performed by a registered professional engineer engaged by the owner:

1. Conduct a detailed hydrologic and hydraulic analysis to determine the need for and methods of increasing the discharge capacity of the dam. This would include investigating the adequacy of the principal spillway weir and discharge channel (bypass canal) and the emergency spillway.
2. Verify the location, methods of construction and if possible, the condition of the outlet modifications (where the 36 inch former principal spillway was cut off and flow was diverted to the twin 12 inch pipes leading to the lower reservoir).

#### d. Urgency

It is recommended that within 3 months of the final approval date of this report, the necessary hydrologic investigation should be undertaken and within 6 months, the remaining investigation should commence. Appropriate remedial measures for both of the additional investigations described in Section 7.1c should be completed within 18 months of the final approval of the report. Corrective measures listed in Section 7.2 should be accomplished within 12 months of final approval.

## 7.2 RECOMMENDED MEASURES

It is considered important that the following items be accomplished in addition to any items required as a result of the additional investigations recommended in Section 7.1c:

- a. Remove all spruce trees that are growing between the crest and lower berm on the left side of the downstream embankment slope, and also any whose trunks or roots may be encroaching onto the right side of the embankment. Trees growing on the abutments may remain. The trees to be removed constitute a potential hazard if uprooted during a storm. This may lead to a loss of freeboard, to a dangerous reduction of embankment width, or to the formation of piping channels if uprooted and the remaining roots rot in place.
- b. The trunks of all cut trees are to be removed and back-filled. Equipment and procedures for this maintenance operation should be such as to avoid damage to existing grass and weed cover on the slopes. Any slopes that become scarred by runoff or traffic should be reseeded and mulched.
- c. Patch the cracks in the concrete apron and repair the separation between the concrete headwall and apron of the emergency spillway inlet to prevent water from flowing up from beneath the apron.
- d. Place rockfill in the bypass canal below the outlet head-wall of the emergency spillway where undermining has begun.
- e. Ensure the reservoir drain and its controls are operational.
- f. Backfill and regrade the areas of minor surface sloughs on the downstream slope.
- g. Regrade the dam crest to remove vehicle ruts and shallow depressions and allow surface runoff without concentrated flow. A gravel surface layer would improve trafficability and reduce rutting.
- h. Continue to periodically cut the brush on the embankment slopes and the bypass canal bottom to prevent their being overgrown.
- i. Fill in the animal burrows observed on the embankment slopes.
- j. Develop and implement a flood warning and emergency evacuation plan to downstream residents public in the event



conditions occur which could result in the failure of the dam.

APPENDIX A  
PHOTOGRAPHS

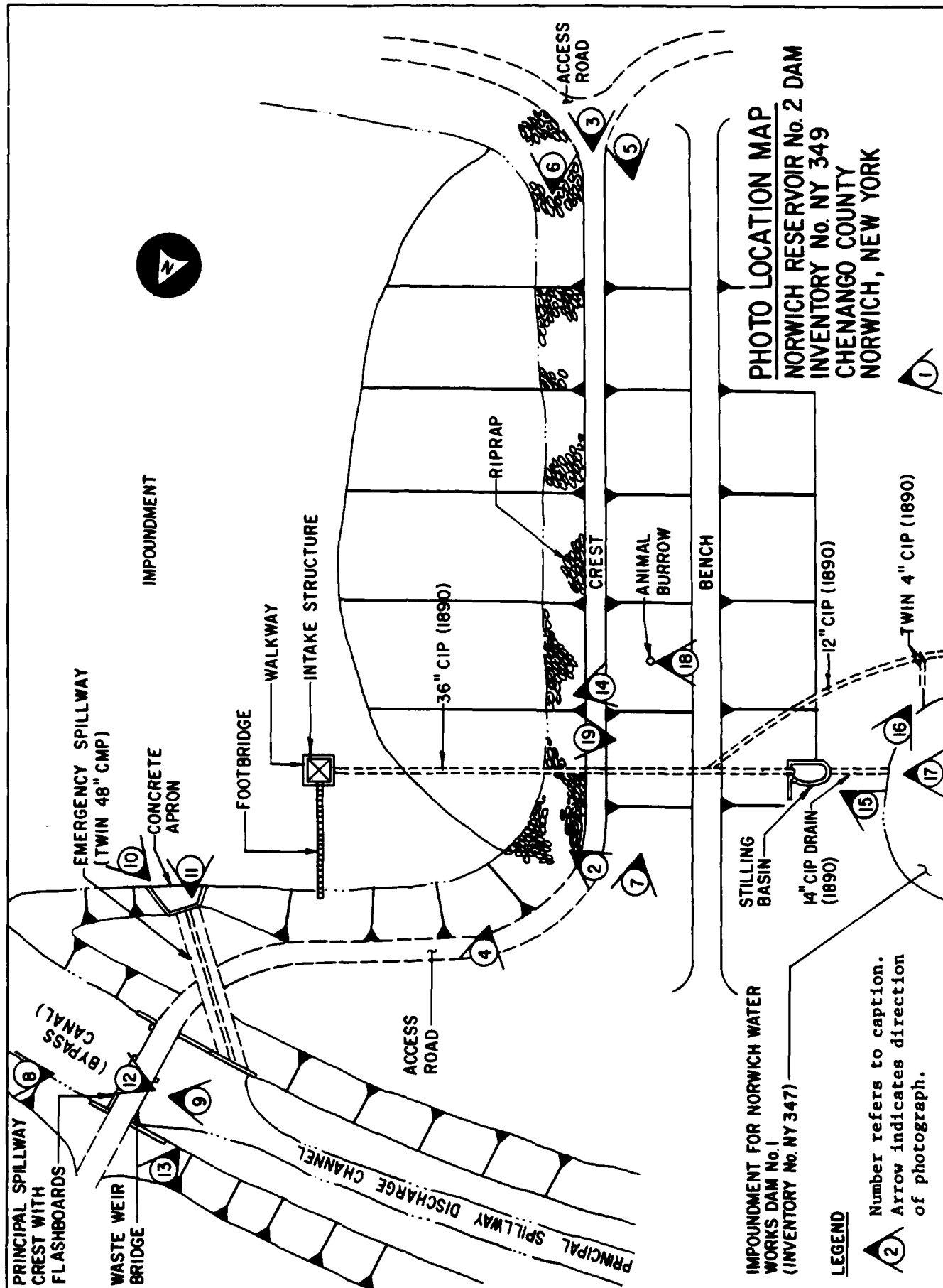




PHOTO #2: Overview of impoundment



PHOTO #3: Crest of dam looking toward  
right abutment



PHOTO #4: Overview of upstream face of dam



PHOTO #5: Overview of downstream face of dam

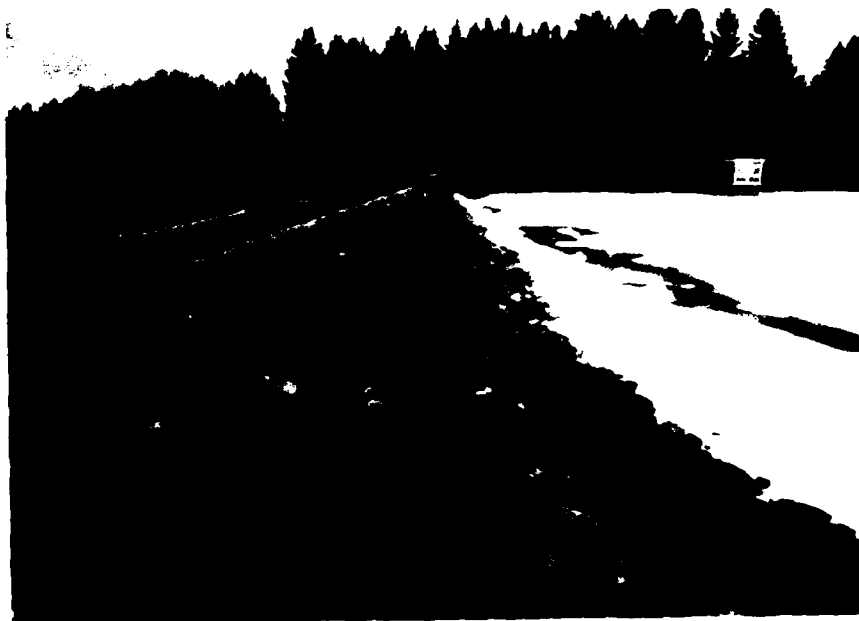


PHOTO #6: Upstream face of dam

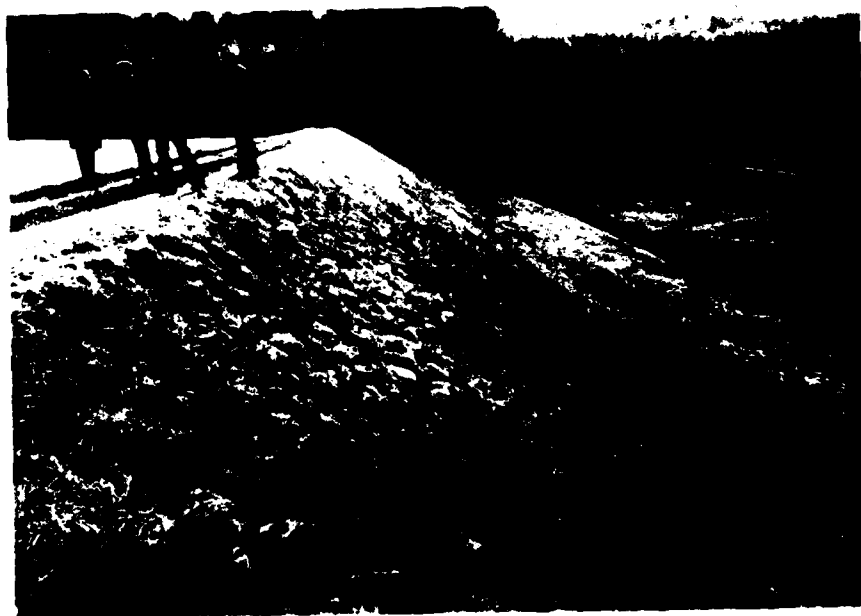


PHOTO #7: Downstream face of dam



PHOTO #8: View of principal spillway from upstream



PHOTO #9: Closeup of flashboards from downstream



PHOTO #10: View of emergency spillway (twin  
48" corrugated metal pipes - CMP)  
from upstream



PHOTO #11: Seepage through joint between  
concrete headwall and apron





PHOTO # 12: Outlet of emergency spillway and downstream channel conditions



PHOTO #13: Closeup of emergency spillway outlet

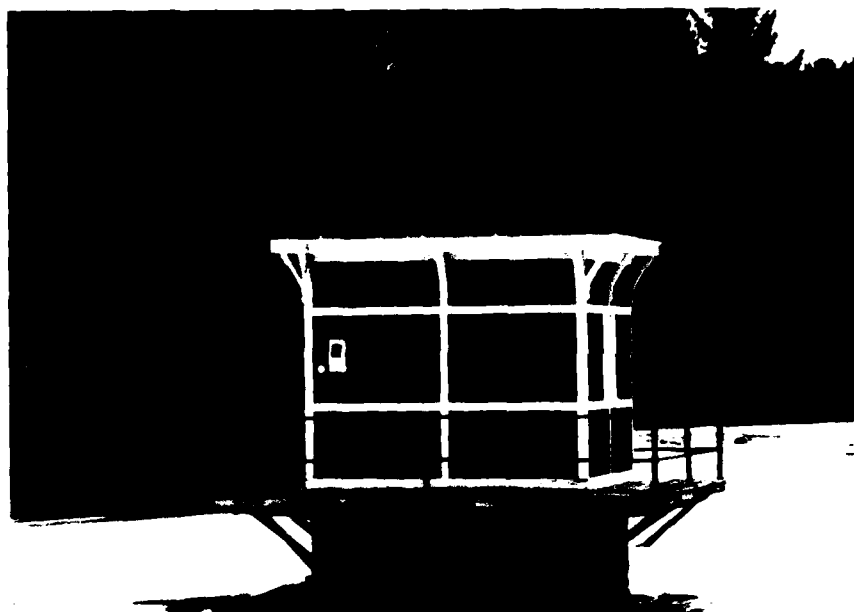


PHOTO #14: Intake structure



PHOTO #15: Outlet works (36" cast iron pipe - CIP)



PHOTO #16: 4" CIP outlet pipe flowing  
nearly full



PHOTO #17: 14" CIP drain from outlet works  
(shown in Photo #15)

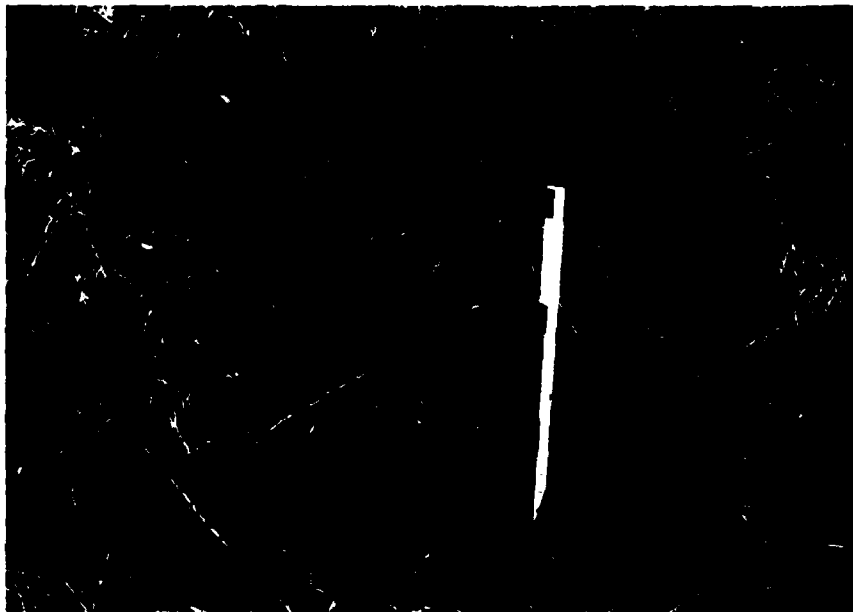


PHOTO #18: Animal burrow



PHOTO #19: Downstream channel conditions -  
impoundment for Norwich Water Works  
Dam No. 1 (Inventory No. NY 347)

APPENDIX B  
VISUAL INSPECTION CHECKLIST

## VISUAL INSPECTION CHECKLIST

### 1) Basic Data

#### a. General

Name of Dam Norwich Reservoir No. 2 Dam  
Fed. I.D. # NY 349 DEC Dam No. 117C-621  
River Basin Susquehanna  
Location: Town Norwich County Chenango  
Stream Name Ransford Creek  
Tributary of Chenango River  
Latitude (N) 42° - 33.0' Longitude (W) 75° - 29.3'  
Type of Dam Earthen embankment  
Hazard Category High  
Date(s) of Inspection March 13, 1981  
Weather Conditions Overcast, 40° ±F.  
Reservoir Level at Time of Inspection Elevation 1244.2 (NGVD)

b. Inspection Personnel R.C. Smith, T.L. Ward & R.A. Criscuolo of Flaherty Giavara Associates, P.C.; J.J. Rixner & C.W. Eller of Haley & Aldrich, Inc.; E. Thomas of Salmon Associates.

c. Persons Contacted (Including Address & Phone No.)  

Nicholas W. Andrews, Superintendent	Thomas J. Natoli, City Engineer
Norwich Water Department	City of Norwich
City of Norwich	P.O. Box 430
31 East Main Street	31 East Main Street
Norwich, New York 13815	Norwich, New York 13815
(607) 334-6618	(607) 334-4427

#### d. History:

Date Constructed 1890 Date(s) Reconstructed Never

Designer Norwich Water Works; W.S. Franklin, Chief Engineer  
Constructed By Troy Public Works Company - Limited  
Owner City of Norwich

2) Embankment

a. Characteristics

- (1) Embankment Material Compacted earth material
- (2) Cutoff Type Compacted clay and gravel (puddled)
- (3) Impervious Core Compacted clay and gravel (puddled)
- (4) Internal Drainage System None observed
- (5) Miscellaneous No comments

b. Crest

- (1) Vertical Alignment Good; minor wheel rutting in roadway
- (2) Horizontal Alignment Good; angled upstream toward the left abutment
- (3) Surface Cracks None observed
- (4) Miscellaneous Mowed grass cover

c. Upstream Slope

- (1) Slope (Estimate - V:H) 1:3
- (2) Undesirable Growth or Debris, Animal Burrows Few mouse/mole burrows  
near the crest
- (3) Sloughing, Subsidence or Depressions Slight surface erosion on right abutment

(4) Slope Protection Layer of riprap with flat platey shale extending within one foot of the crest; one foot strip of grass at crest; heavier grass and brush cover at the abutments.

(5) Surface Cracks or Movement at Toe None evident

d. Downstream Slope

(1) Slope (Estimate - V:H) 1:2

(2) Undesirable Growth or Debris, Animal Burrows Several woodchuck burrows near the toe of slope; pine and spruce (6 inch - 24 inch in diameter) cover the left abutment and slope.

(3) Sloughing, Subsidence or Depressions Two minor surface sloughs were noted near the right abutment; some erosion of surface soil through the stone below

(4) Surface Cracks or Movement at Toe None observed

(5) Seepage None evident

(6) External Drainage System (Ditches, Trenches, Blanket) None observed

(7) Condition Around Outlet Structure Dry stone masonry stilling basin in good condition

(8) Seepage Beyond Toe None observed

e. Abutments - Embankment Contact

Right: good condition

Left: good condition



(1) Erosion at Contact None apparent

(2) Seepage Along Contact None observed

3) Drainage System

a. Description of System Masonry and wood intake structure with a 36 inch diameter cast iron pipe (CIP) feeds water into the distribution system through a 12 inch CIP from which two 4 inch CIP blowoffs discharge into the lower reservoir (NY 347)

b. Condition of System Fair; some valves have not been opened or closed in years and may be inoperable

c. Discharge from Drainage System Stilling basin and riprapped outlet

4) Instrumentation (Monumentation/Surveys, Observation Wells, Weirs, Piezometers, Etc.)

None observed

5) Reservoir

a. Slopes Moderately to steeply sloping woodlands

b. Sedimentation No apparent problems

c. Unusual Conditions Which Affect Dam None apparent

6) Area Downstream of Dam

a. Downstream Hazard (No. of Homes, Highways, etc.) Approximately 2 dwellings, a large trailer park (30 to 40 trailers), 4 commercial buildings, two major roads (including New York Route 23) and high voltage transmission lines are within the dam failure flood hazard area

b. Seepage, Unusual Growth

None observed

c. Evidence of Movement Beyond Toe of Dam None evident

d. Condition of Downstream Channel Not applicable

7) Spillway(s) (Including Discharge Conveyance Channel)

Principal spillway, emergency spillway and discharge conveyance channel (bypass canal)

a. General Principal spillway and discharge conveyance channel (bypass canal) handle normal flows while the emergency spillway conveys flow during overflow conditions

b. Condition of Principal Spillway Good; minor seepage around right abutment; some open joints in masonry

c. Condition of Emergency Spillway Some seepage through the joint between the  
concrete apron and headwall at the inlet to the twin 48 inch CMP; cracks  
observed in the concrete apron; the center of the concrete endwall has  
been undermined by 9 ± inches.

d. Condition of Discharge Conveyance Channel Fair; side slopes have a moderate  
growth of trees and brush but appear stable

8) Reservoir Drain/Outlet

Type: Pipe X Conduit \_\_\_\_\_ Other \_\_\_\_\_

Material: Concrete \_\_\_\_\_ Metal X Other \_\_\_\_\_

Size: 36 inch cast iron pipe (CIP) Length 200 feet

Invert Elevations: Entrance 1205.0 (NGVD) Exit 1199.4 (NGVD)

Physical Condition (Describe): \_\_\_\_\_ Unobservable \_\_\_\_\_

Material: Rust was visible at the outlet

Joints: Unobservable Alignment Straight

Structural Integrity: Good

Hydraulic Capability: Good; pipe is used for water supply for the City of  
Norwich

Means of Control: Gate \_\_\_\_\_ Valve X Uncontrolled \_\_\_\_\_

Operation: Operable \_\_\_\_\_ Inoperable \_\_\_\_\_ Uncontrolled \_\_\_\_\_

Present Condition (Describe): Unknown; the valve was not operated during  
the inspection

9) Structural

- a. Concrete Surfaces Concrete surfaces of the emergency spillway inlet have several cracks.
- b. Structural Cracking Minor shrinkage cracks were observed
- c. Movement - Horizontal & Vertical Alignment (Settlement) Numerous settlement cracks up to  $\frac{1}{4}$  inch wide at the inlet (See the sketch on page B-11)
- d. Junctions with Abutments or Embankments A  $\frac{3}{8}$  inch separation was observed between the headwall and the right wingwall (See the sketch on page B-11)
- e. Drains - Foundation, Joint, Face None evident
- f. Water Passages, Conduits, Sluices 36 inch cast iron water supply pipe from the intake structure having a 12 inch cast iron pipe branching off to the distribution system.
- g. Seepage or Leakage Some seepage was noted through the joint separation mentioned in 9)d. above.

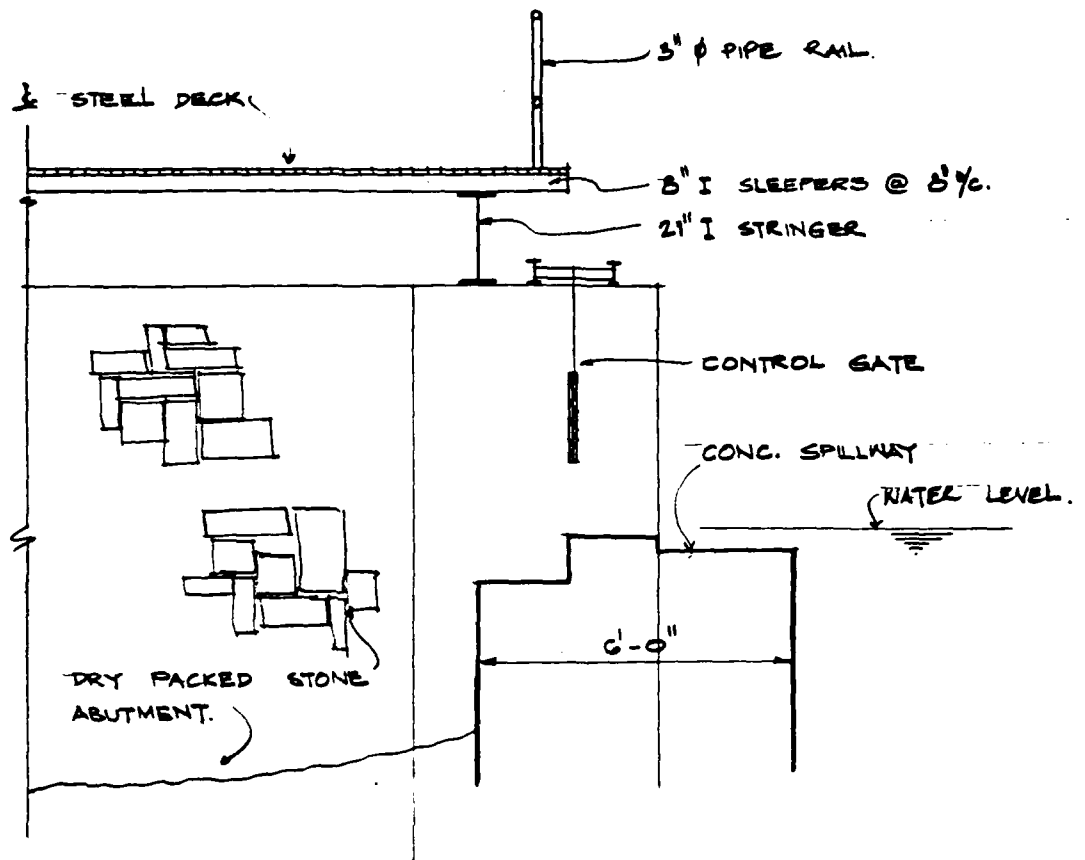
- h. **Joints - Construction, etc.** Some open joints in stone masonry of the principal spillway; no indication of reinforcement between the wingwalls and the headwall of the emergency spillway inlet.
- i. **Foundation** Inaccessible
- j. **Abutments** Minor openings in masonry joints as noted in 9)h. above
- k. **Control Gates** Valves control the flow of water to the distribution system
- l. **Approach & Outlet Channels** Concrete surface is cracked at the approach to the emergency spillway.
- m. **Energy Dissipators (Plunge Pool, etc.)** Stilling basin at the outlet of the 36 inch diameter cast iron water supply pipe.
- n. **Intake Structures** Stone masonry and wood structure with access footbridge in good condition
- o. **Stability** Appears to be stable
- p. **Miscellaneous** No comments

10) Appurtenant Structures (Power House, Lock, Gatehouse, Other)

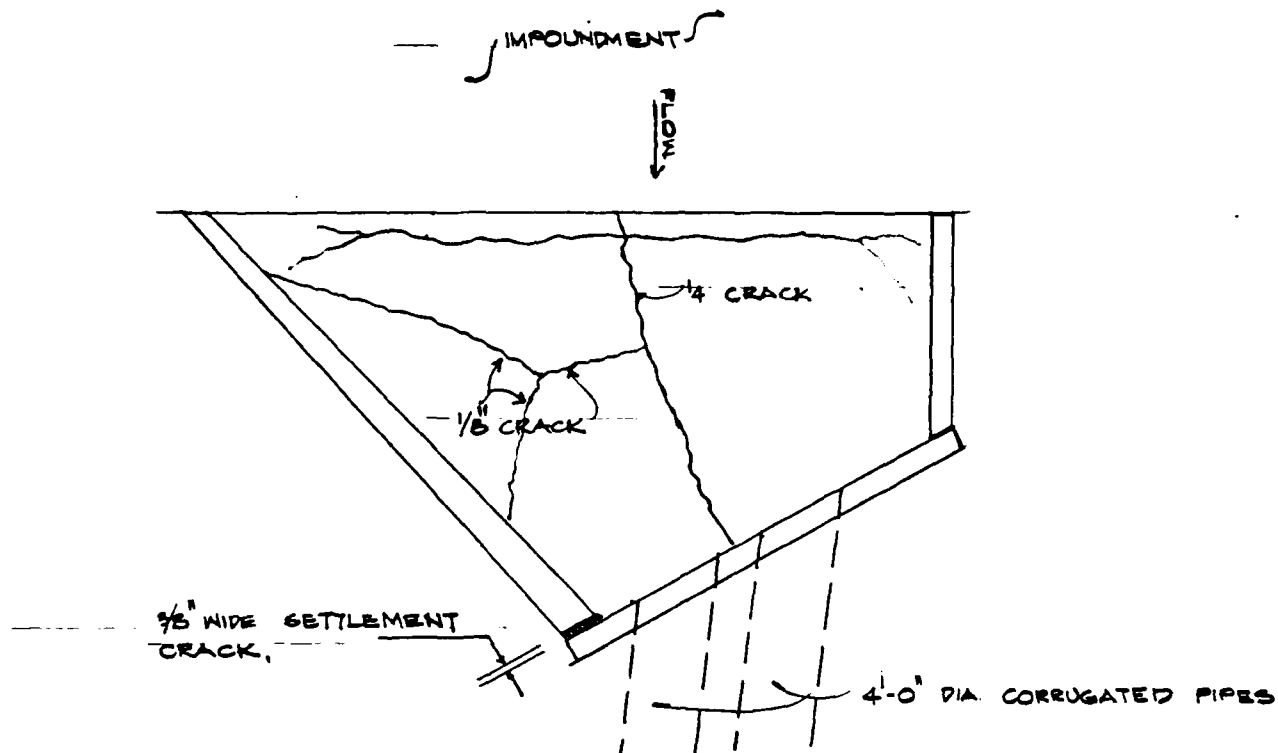
a. Description and Condition

1. Intake structure: It appears to be in good condition.

2. Bridge over principal spillway weir: Good condition.

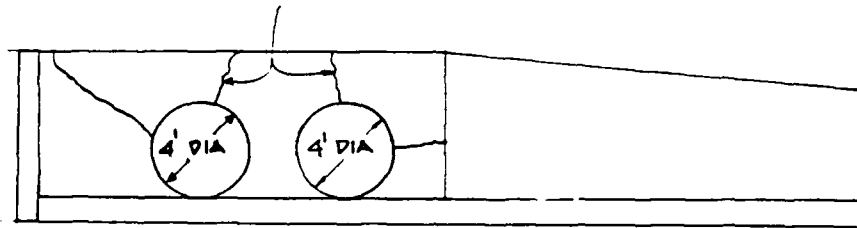


SECTION THRU CONC. SPILLWAY AT BRIDGE.  
(N.T.S)



PLAN OF EMERGENCY SPILLWAY.  
(N.T.S)

1/8\" WIDE CRACKS.

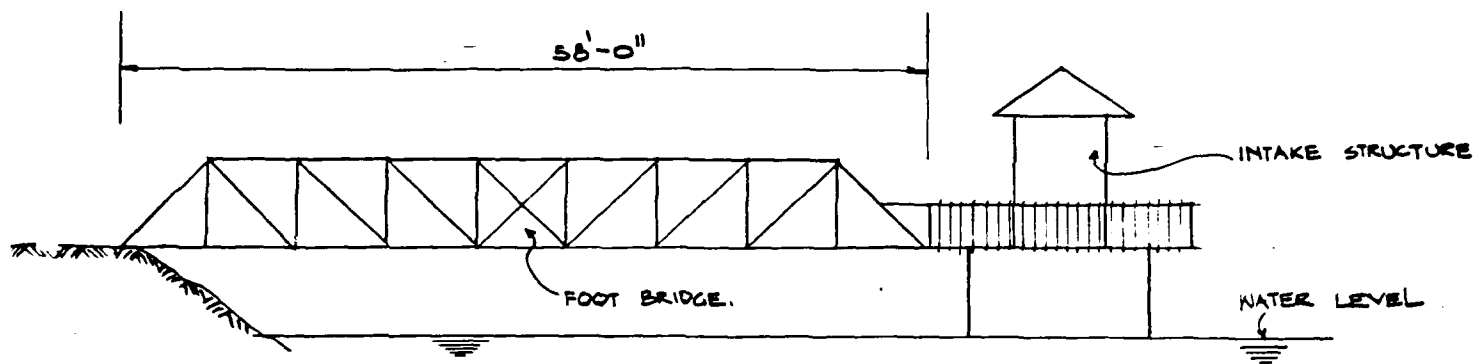


ELEVATION OF EMERGENCY SPILLWAY.  
(N.T.S)



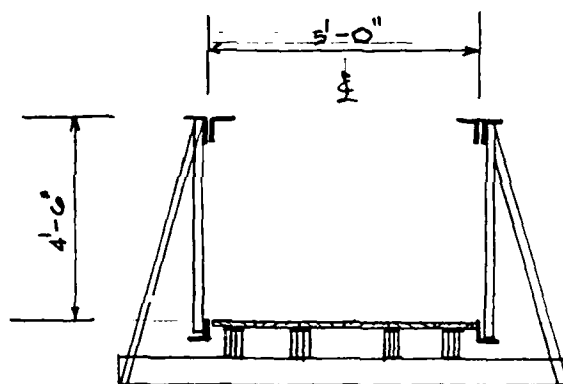
NAME OF DAM : NORWICH RESERVOIR NO 2

FED. I.D. NO : 349



ELEVATION OF INTAKE STRUCTURE & FOOT BRIDGE.

(N.T.S)



SECTION THRU FOOT BRIDGE.

(N.T.S)

APPENDIX C .

HYDROLOGIC/HYDRAULIC ENGINEERING DATA AND COMPUTATIONS

CHECK LIST FOR DAMS  
HYDROLOGIC AND HYDRAULIC  
ENGINEERING DATA

AREA-CAPACITY DATA:

	<u>Elevation</u> (ft.)	<u>Surface Area</u> (acres)	<u>Storage Capacity</u> (acre-ft.)
1) Top of Dam	<u>1249.0</u>	<u>12.0</u>	<u>222</u>
2) Design High Water (Max. Design Pool)	<u>--</u>	<u>--</u>	<u>--</u>
3) Emergency Spillway Crest	<u>1245.6</u>	<u>10.0</u>	<u>189</u>
4) Pool Level with Flashboards	<u>1245.4</u>	<u>9.9</u>	<u>187</u>
5) Principal Spillway Crest	<u>1244.1</u>	<u>9.1</u>	<u>176</u>

DISCHARGES:

	<u>Volume</u> (cfs)
1) Average Daily	<u>Unknown</u>
2) Emergency Spillway @ Maximum High Water (Top of Dam)	<u>126</u>
3) Principal Spillway @ Maximum High Water (Top of Dam)	<u>808</u>
4) Principal Spillway @ Emergency Spillway Crest	<u>95</u>
5) Low Level Outlet @ Principal Spillway Crest	<u>--</u>
6) Total (of all facilities) @ Maximum High Water	<u>934</u>
7) Maximum Known Flood	<u>Unknown</u>
8) At Time of Inspection	<u>0</u>

CREST:

ELEVATION: 1249.0

Type Vegetated earthen embankment

Width 10 feet

Length 638 feet

Spillover Cut stone masonry and concrete spillway

Location Beyond and upstream of the right abutment

SPILLWAY:

PRINCIPAL		EMERGENCY	
<u>1244.1 (NGVD)</u>	<u>Elevation</u>	<u>1245.6 (NGVD)</u>	
<u>Broad-crested weirs</u>	<u>Type</u>	<u>Twin 48 inch CMP</u>	
<u>13.0 feet and 16.7 feet</u>	<u>Width</u>	<u>15 feet @ entrance to pipes;</u>	
		<u>32 feet @ concrete apron</u>	
	<u>Type of Control</u>		
<u>Weir</u>	<u>Uncontrolled</u>	<u>Weir</u>	
<u>--</u>	<u>Controlled</u>	<u>--</u>	
<u>Flashboards</u>	<u>Type:</u>	<u>None</u>	
	<u>(Flashboards; gate)</u>		
<u>One</u>	<u>Number</u>	<u>One</u>	
<u>2.5 feet high/ 16.7 feet</u>	<u>Size/Length</u>	<u>32 foot weir/ 18 feet long</u>	
		<u>2-48 inch CMP/112 feet long</u>	
<u>Reinforced concrete</u>	<u>Invert Material</u>	<u>Reinforced concrete and corrugated metal</u>	
<u>Continuously</u>	<u>Anticipated Length</u>	<u>Unknown</u>	
	<u>of Operating Service</u>		
<u>Not applicable</u>	<u>Chute Length</u>	<u>18 feet</u>	
<u>1 ± foot</u>	<u>Height Between</u>	<u>1 ± foot</u>	
	<u>Spillway Crest</u>		
	<u>&amp; Approach Channel</u>		
	<u>Invert (Weir Flow)</u>		

Type: \_\_\_\_\_

Location: \_\_\_\_\_

Records:

Date Unknown

Max. Reading Unknown

FLOOD WATER CONTROL SYSTEM:

Warning System None in effect

Method of Controlled Releases (mechanisms) Valves used to control flow to the  
water distribution system; flashboards used to regulate reservoir levels.

DRAINAGE AREA: 2424 acres = 3.79 square miles

DRAINAGE BASIN RUNOFF CHARACTERISTICS:

Land Use - Type Rural, agriculture

Terrain - Relief Moderate slopes

Surface - Soil Glacial till

Runoff Potential (existing or planned extensive alterations to existing surface or subsurface conditions)

Primarily open fields with scattered woodlands; glacial till soils;  
average watershed slope is 5 to 10 percent; some residential homes  
and roadways.

Potential Sedimentation problem areas (natural or man-made; present or future)

None

Potential Backwater problem areas for levels at maximum storage capacity including surcharge storage:

None

Dikes - Floodwalls (overflow & non-overflow) - Low reaches along the reservoir perimeter:

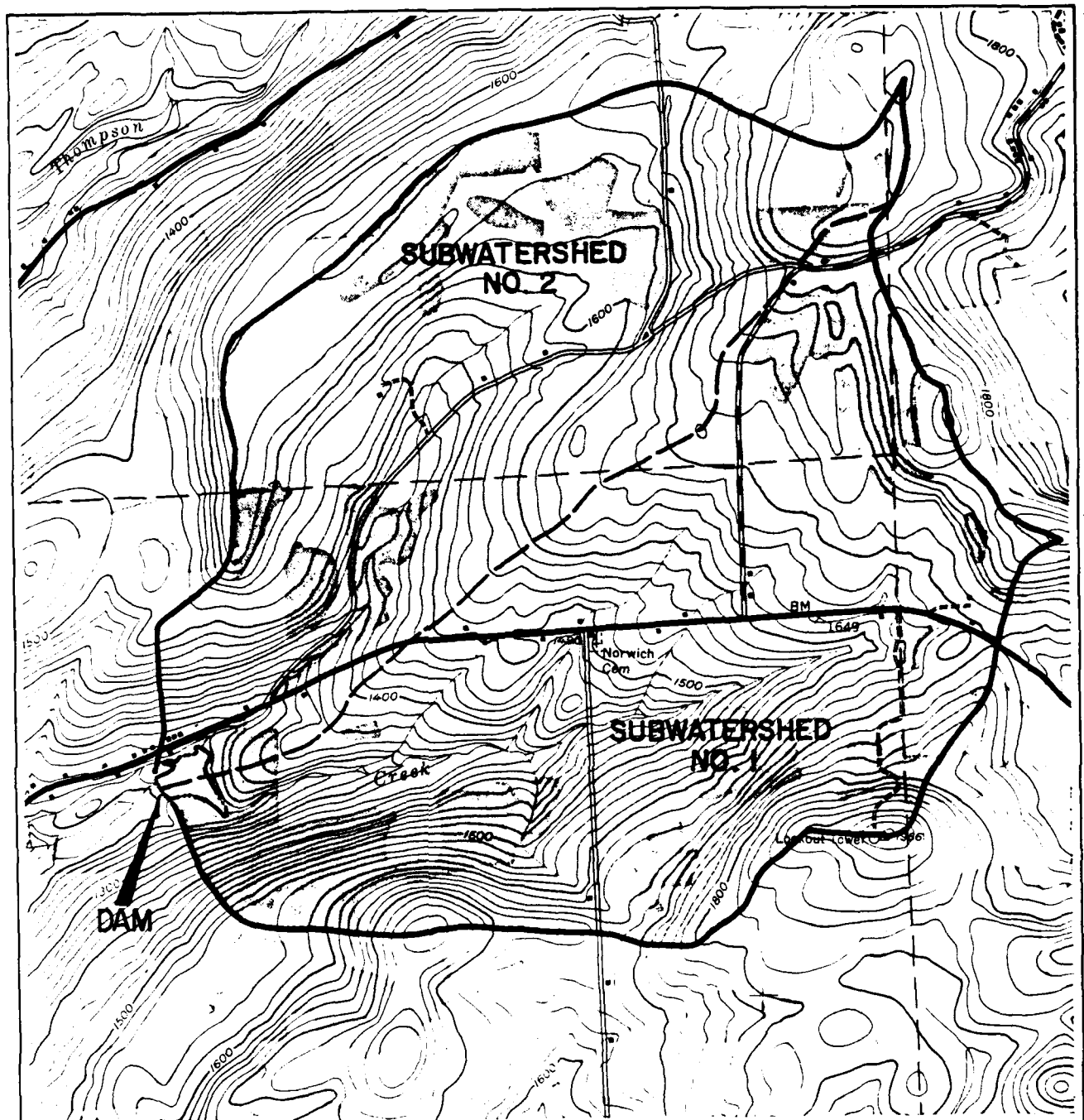
Location: None

Elevation: \_\_\_\_\_

Reservoir:

Length @ Maximum Pool 1000  $\pm$  feet = 0.2 miles (Miles)

Length of Shoreline (@ Spillway Crest) 3500  $\pm$  feet = 0.7 miles (Miles)



## WATERSHED MAP

**NORWICH RESERVOIR No. 2 DAM  
INVENTORY No. NY 349**

**SUSQUEHANNA RIVER BASIN  
CHENANGO COUNTY  
NORWICH, NEW YORK**



0 2000 4000

SCALE IN FEET

FLAHERTY · GIAVARA ASSOCIATES, P.C.

CALCULATIONS



PROJECT 100  
100  
100



**FLAHERTY-GIAVARA ASSOCIATES**  
 ENVIRONMENTAL DESIGN CONSULTANTS  
 ONE COLUMBUS PLAZA, NEW HAVEN, CONN. 06510/203/789-1280

SHEET NO. 1 OF 15  
 BY RA DATE 5-23-88  
 CHK'D BY TLW DATE 5-7-91

## WATERSHED DATA FOR NO. 1 SUBWATERSHED

1) Time to Peak - Sub-Watershed No. 1

$$L = 15,500 \text{ ft} = 2.94 \text{ miles}$$

$$L_c = 8,000 \text{ ft} = 1.52 \text{ miles}$$

$C_t = 2.0$  for average slopes

$$T_p = 2.0(2.94 \times 1.52)^{0.3} = 3.13 \text{ Hours}$$

$$t_r = \frac{t_p}{5.5} = \frac{3.13}{5.5} = 0.57 \text{ USE } t_r = 0.5$$

$$t_{pR} = t_p + 0.25(t_r - t_r) \\ = 3.13 + 0.25(0.5 - 0.57) = 3.11 \text{ Hours}$$

$$\text{DRAINAGE AREA} = 1340.7 \text{ Acres} = 2109 \text{ mi}^2$$

2) Time to Peak - Sub-Watershed No. 2

$$L = 15,000 \text{ ft} = 2.84 \text{ miles}$$

$$L_c = 7,000 \text{ ft} = 1.33 \text{ miles}$$

$C_t = 2.0$  for average slopes

$$T_p = 2.0(2.84 \times 1.33)^{0.3} = 2.93 \text{ Hours}$$

$$t_r = \frac{t_p}{5.5} = \frac{2.93}{5.5} = 0.54 \text{ USE } t_r = 0.5$$

$$t_{pR} = t_p + 0.25(t_r - t_r) \\ = 2.93 + 0.25(0.5 - 0.54) = 2.97 \text{ Hours}$$

$$\text{Drainage Area} = 1083.6 \text{ Acres} = 169 \text{ mi}^2$$

3) To Inserv...

...

$$\text{Round } 1340.7 \times 0.5 = 670.35$$

$$\text{Round } 203 \times 1000 = 203000$$

$$495 = 14 \text{ Acres}$$

1.4 Acres

PROJECT WATER TREATMENT PLANT  
NO. 33



**FLAHERTY-GIAVARA ASSOCIATES**  
 ENVIRONMENTAL DESIGN CONSULTANTS  
 ONE COLUMBUS PLAZA, NEW HAVEN, CONN. 06510/203/789-1200

SHEET NO. 2 OF 13  
 BY RAC DATE 3-26-91  
 CHK'D BY TLW DATE 5-7-91

Watershed NO 2

Roads  $18,000 \text{ ft}^2 \times 1.0 = 18,000 \text{ ft}^2$   
 Houses  $10 \pm @ 1000 \text{ ft}^2 = 10,000 \text{ ft}^2$   
 $18,000 \text{ ft}^2 + 10,000 \text{ ft}^2 = 28,000 \text{ ft}^2 = 10.6 \text{ Acres}$

$\frac{10.6 \text{ Acres}}{1083.6 \text{ Acres}} = 1.0\%$

4) Rainfall Data (From hydrometeorological Report No. 33).

24 Hour Duration PMP = 20.2 inches for  
 200 square miles

Duration in

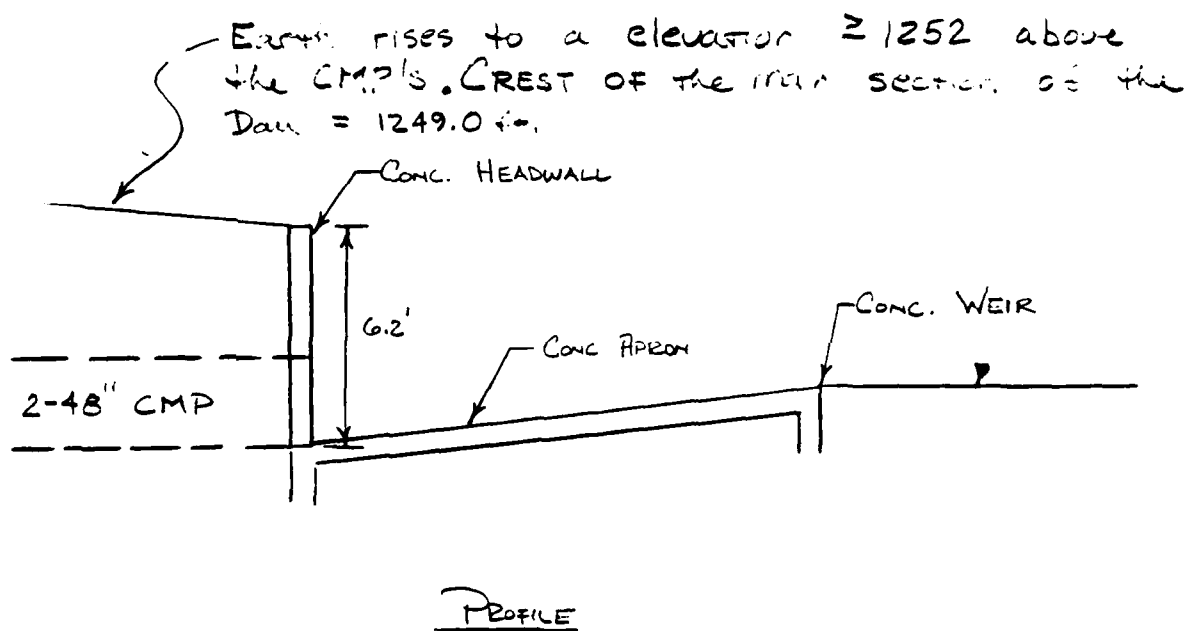
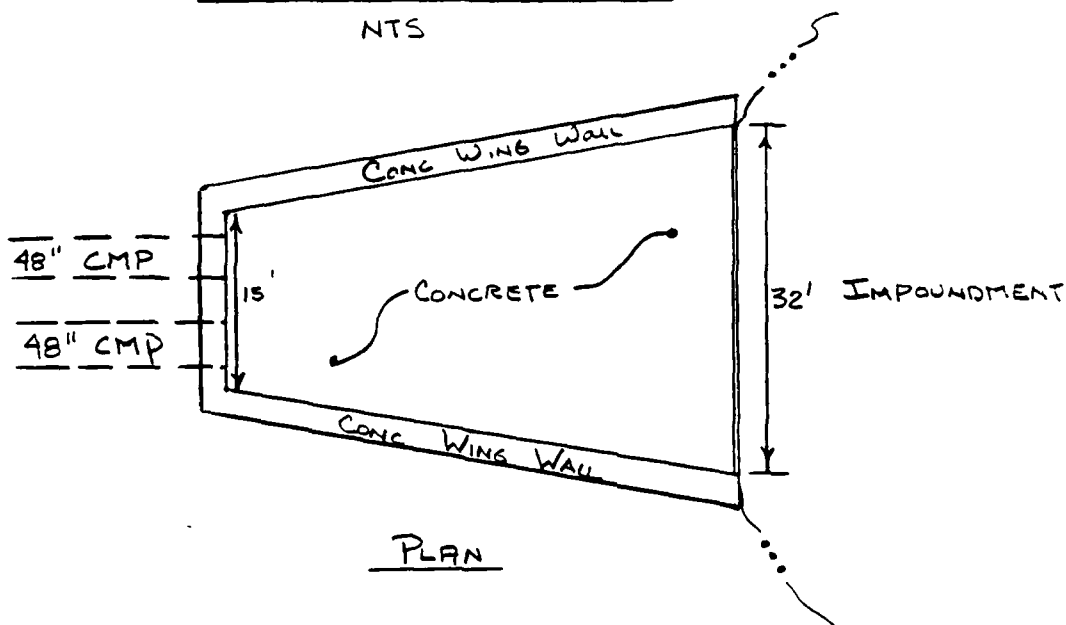
Adj. Factor %

6	111
12	122
24	133
48	143



EMERGENCY SPILLWAY

NTS





## EMERGENCY SPILLWAY

The outlet capacity of the emergency spillway (2-48" cmp) was determined by examining the structure for different controlling flow conditions that may differ depending on the head acting on the structure. Flow conditions were looked at in the following order - A) Flow over the triangular concrete weir, B) assuming inlet control, C) assuming outlet control, and D) for open channel flow.

A stage discharge curve was plotted for the four flow conditions and a final stage discharge curve was derived from the plot by selecting the controlling discharge for a given stage. It was assumed that no submergence of the spillway will take place, but submergence is possible.

Overtopping of the dam was assumed to occur over the main crest of the dam only. Elevations from the HEC-1DE output reflect overtopping of the main section only (No bulging A.S.).

PROJECT CORPS DAM  
N. 345



**FLAHERTY-GIAVARA ASSOCIATES**  
 ENVIRONMENTAL DESIGN CONSULTANTS  
 ONE COLUMBUS PLAZA NEW HAVEN CONN 06510/203/789-1280

SHEET NO. 5 OF 13  
 BY SLC DATE 4-1-9  
 CHK'D. BY TLW DATE 5-7-9

## EMERGENCY SPILLWAY

A) WEIR @ 2-48" PIPE:

SLOPE OF Triangular weir  $\approx 10$  to 1

$$Q = CLH^{1.5}$$

L = Length @ Impoundment = 32'

<u>H(FT)</u>	<u>C</u>	<u>Q(CFS)</u>	<u>ELEV (SU)</u>
0	-	-	1245.6
0.2	2.82	3.1	1245.8
0.4	2.83	22.9	1246.0
0.6	2.86	42.5	1246.2
0.8	2.90	66.4	1246.4
1.0	2.91	93.1	1246.6
1.2	2.92	122.3	1246.8
1.5	2.93	172.2	1247.1

PROJECT                       
                      
                    



**FLAHERTY-GIAVARA ASSOCIATES**  
 ENVIRONMENTAL DESIGN CONSULTANTS  
 ONE COLUMBUS PLAZA, NEW HAVEN, CONN 06510/203/789-1200

SHEET NO. 6 OF 13  
 BY TLV DATE 5-1-81  
 CHK'D BY TLV DATE 5-7-81

## STAGE DISCHARGE FOR EMERGENT SPECIES

2-45 100% S

### B) INLET CONTROL

<u>L</u>	<u>1/H</u>	<u>Q</u>	<u>2Q</u>	<u>ELEV (JMSM)</u>
1.2	0.3	2 Crest of Cont. Hdr		1245.6
1.5	0.4	16	32	1245.9
2.0	0.5	23	46	1246.4
2.5	0.6	32	64	1246.9
3.0	0.8	55	110	1247.4
3.5	0.9	70	140	1247.9
4.0	1.0	73	146	1248.4
4.5	1.1	80	160	1248.9
4.6	1.2	11	22	249.0
5.0	1.3	100	200	1249.4
5.5	1.4	110	220	1249.9
6.0	1.5	111	232	1250.4
6.5	1.6	125	250	1250.9
7.0	1.8	140	280	1251.4

INLET AND OUTLET STAGE DISCHARGES FOR  
 HOLLOW CONCRETE PIPE DOWNSLOPE  
 TERMINATING IN A 12" DIA. 10' LONG  
 1.5% HYDRAULIC CHARTS FOR THE 12" DIA. 10' LONG  
 CONCRETE CONDUITS

FOR INLET CONTROL APPROXIMATE VELOCITY WAS  
 NEGLECTED.



## EMERGENCY SPILLWAY DATA

### C) OUTLET CONTROL

$$L = 112'$$

$$C = 0.024$$

$$K_E = 0.15$$

$$T_u \text{ assume} = T_o \text{ top of } T_u \text{ man, } E_{LEV} = 1243.6$$

$$W = H + h_o - L S_o = H + 4 - 0.3$$

<u>H (FT)</u>	<u>Q (CFS)</u>	<u>2Q (CFS)</u>	<u>HW</u>	<u>ELEV USGS</u>
0.5	40	80	4.2	1249.1
1.0	55	110	4.7	1249.6
2.0	77	154	5.7	1249.6
3.0	95	190	6.7	1250.6
4.0	110	220	7.7	1251.6
5.0	121	242	8.7	1252.6
6.0	135	270	9.7	1253.6
7.0	150	300	10.7	1254.6

### D) OPEN CHANNEL FLOW

$$I_{NU} = 1243.9, \text{ flow starts @ } 1245.9 \text{ due to } T_u$$

$$C = 0.024$$

<u>D (FT)</u>	<u>Q<sub>100yr</sub> (CFS)</u>	<u>Q<sub>100yr</sub> (CFS)</u>	<u>Q<sub>TOTAL</sub> (CFS)</u>	<u>ELEV (FT)</u>
0.5	14	1.0	24	1244.4
1.0	21.0	4.5	11.3	1244.9
1.5	13.5	10.5	24.0	1245.4
2.0	22.0	16.0	38.0	1245.9
2.5	40.0	30.0	70.0	1246.0
3.0	47.0	35.0	82.0	1247.0

Open Channel Flow From Nomographs Found in U.S.  
 DEPARTMENT OF TRANSPORTATIONS, HYDRAULIC DESIGN SERIES  
 1.1 E, (DESIGN CHANNEL FOR OPEN CHANNEL FLOW).

PROJECT 14 345

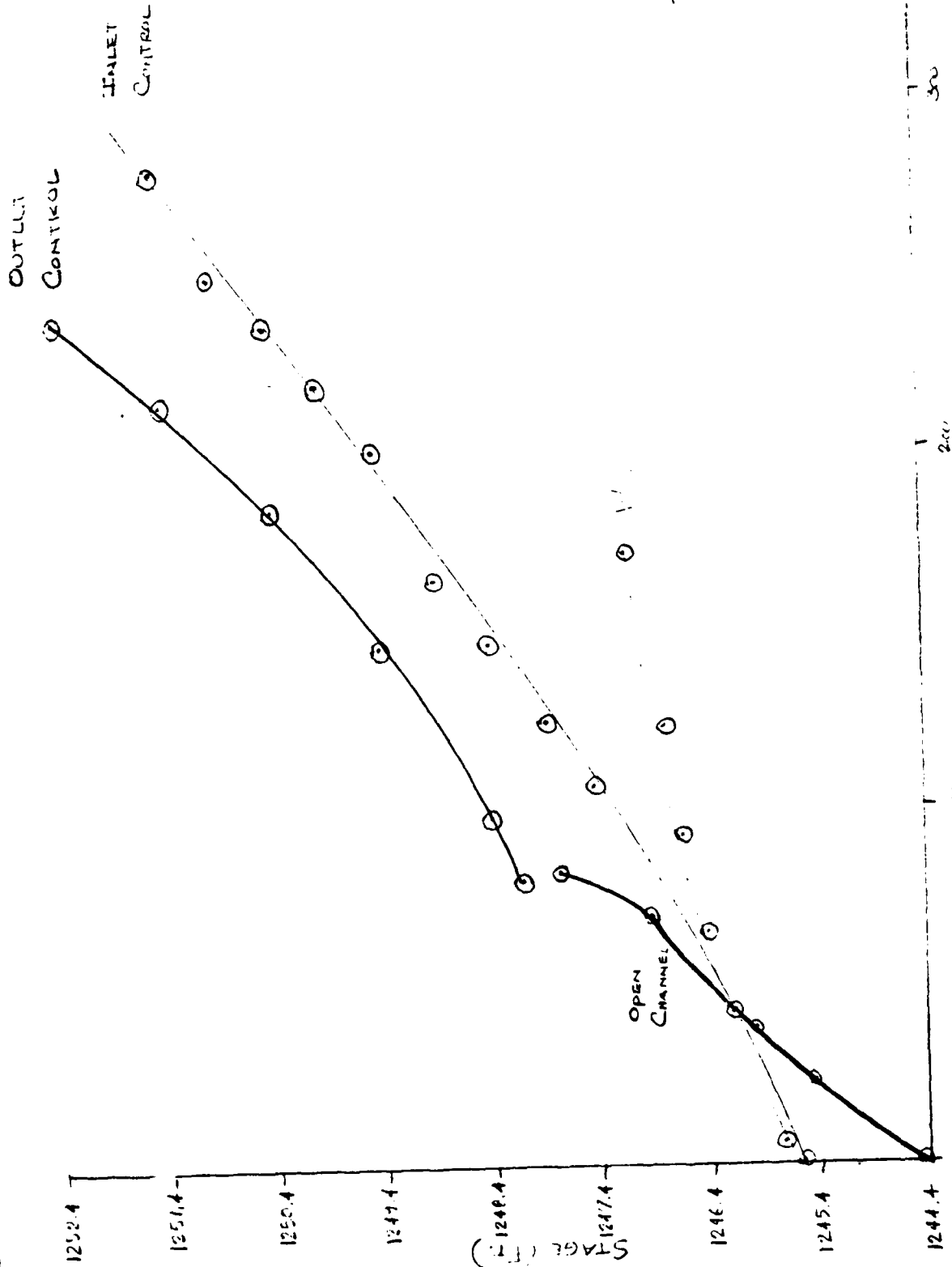


**FLAHERTY-GIAVARA ASSOCIATES**  
 ENVIRONMENTAL DESIGN CONSULTANTS  
 ONE COLUMBUS PLAZA NEW HAVEN CONN 06510/203/789-1280

SHEET NO. 3 OF 13  
 BY FLG DATE 4-2-81  
 CHK'D BY TLW DATE 5-7-81

# STAGE DISCHARGE CURVE

## EMERGENCY SPILLWAY

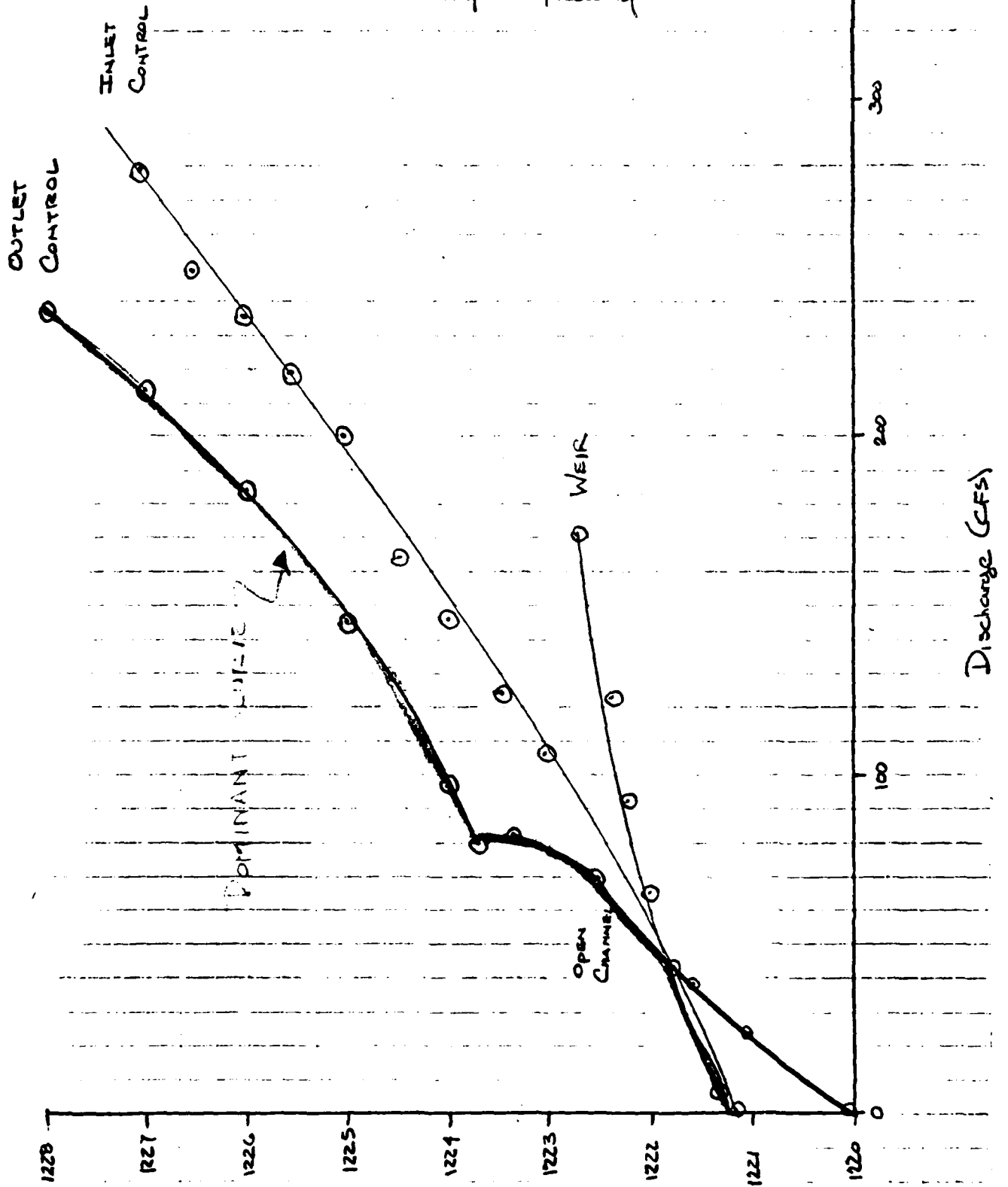






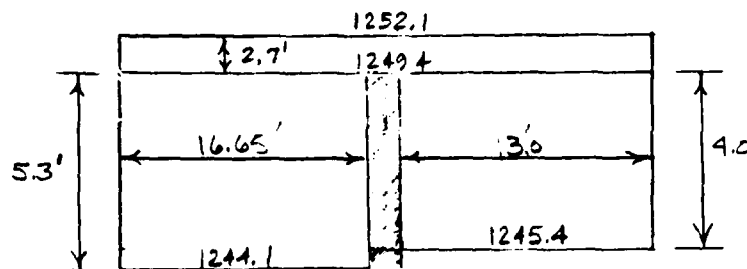
# STAGE DISCHARGE CURVE

## EMERGENCY Spillway





PRINCIPAL SPILLWAY



C=3.0

C=3.0

$$Q = (3) L H^{1.5}$$

STAGE (FT)

DISCHARGE (CFS)

1244.1	0
1244.4	8.2
1245.4	74.0
1245.6	95.3
1246.4	213.2
1247.4	409.7
1248.4	649.0
1249.0	849.2
1249.4	1011.5

@ 1250.4  $Q = C A \sqrt{2gH}$

$$Q_1 = 0.6 (88.25) \sqrt{2 \times 32.2 \times 37}$$

$$= 817.4$$

$$Q_2 = 0.6 (52) \sqrt{2 \times 32.2 \times 35}$$

$$= 711.7$$

$$Q_T = 1251.1 \text{ CFS}$$

@ 1251.4

$$Q = 0.6 (88.25) \sqrt{2 \times 32.2 \times 47}$$

$$= 921.2$$

$$Q_2 = 0.6 (52) \sqrt{2 \times 32.2 \times 45}$$

$$= 800.6$$

$$Q_T = 1422.0 \text{ CFS}$$

@ 1252.4

$$Q_1 = 0.6 (88.25) \sqrt{2 \times 32.2 \times 57}$$

$$= 1014.5$$

$$Q_2 = 0.6 (52) \sqrt{2 \times 32.2 \times 55}$$

$$= 859.7$$

$$Q_3 = (2.5) (40) (52)^{1.5} = 16.4$$

$$Q_T = 1590.8 \text{ CFS}$$

PROJECT 0000  
1.034



**FLAHERTY-GIAVARA ASSOCIATES**  
 ENVIRONMENTAL DESIGN CONSULTANTS  
 ONE COLUMBUS PLAZA, NEW HAVEN, CONN 06510/203/789-1280

SHEET NO. 11 OF 13  
 BY RAC DATE 4-1-81  
 CHK'D. BY TLV DATE 5-7-81

③ 1253.4

$$Q_1 = (0.6)(88.25) \sqrt{2 \times 32.2 \times 6.7} = 1099.1$$

$$Q_2 = (0.6)(52) \sqrt{2 \times 32.2 \times 6.7} = 662.3$$

$$Q_3 = (2.5)(40)(1.3)^{1.5} = 148.2$$

$$Q_T = 1861.4 \text{ cfs}$$

② 1254.4

$$Q_1 = (0.6)(88.25) \sqrt{2 \times 32.2 \times 7.7} = 1179.1$$

$$Q_2 = (0.6)(52) \sqrt{2 \times 32.2 \times 7.7} = 662.4$$

$$Q_3 = (2.5)(40)(2.3)^{1.5} = 348.8$$

$$Q_T = 2190.3 \text{ cfs}$$



Cumulative Stage Discharge  
 Principal & Emergency Spillways

STAGE (FT)	PRINCIPAL (CFS)	EMERGENCY (CFS)	TOTAL (CFS)
1244.1	0	-	0
1244.4	8.2	-	8.2
1245.4	74.0	-	74.0
1245.6	95.3	-	95.3
1246.4	213.2	50.0	263.2
1247.1	409.7	77.0	486.7
1248.4	548.0	100.0	648.0
1249.0	563.2	123.0	686.2
1249.4	921.5	145.0	1066.5
1250.4	1251.1	183.0	1434.1
1251.4	1422.0	214.0	1636.0
1252.4	1595.8	233.0	1828.8
1253.4	1861.4	268.0	2129.4
1254.4	2112.3	394.0	2506.3

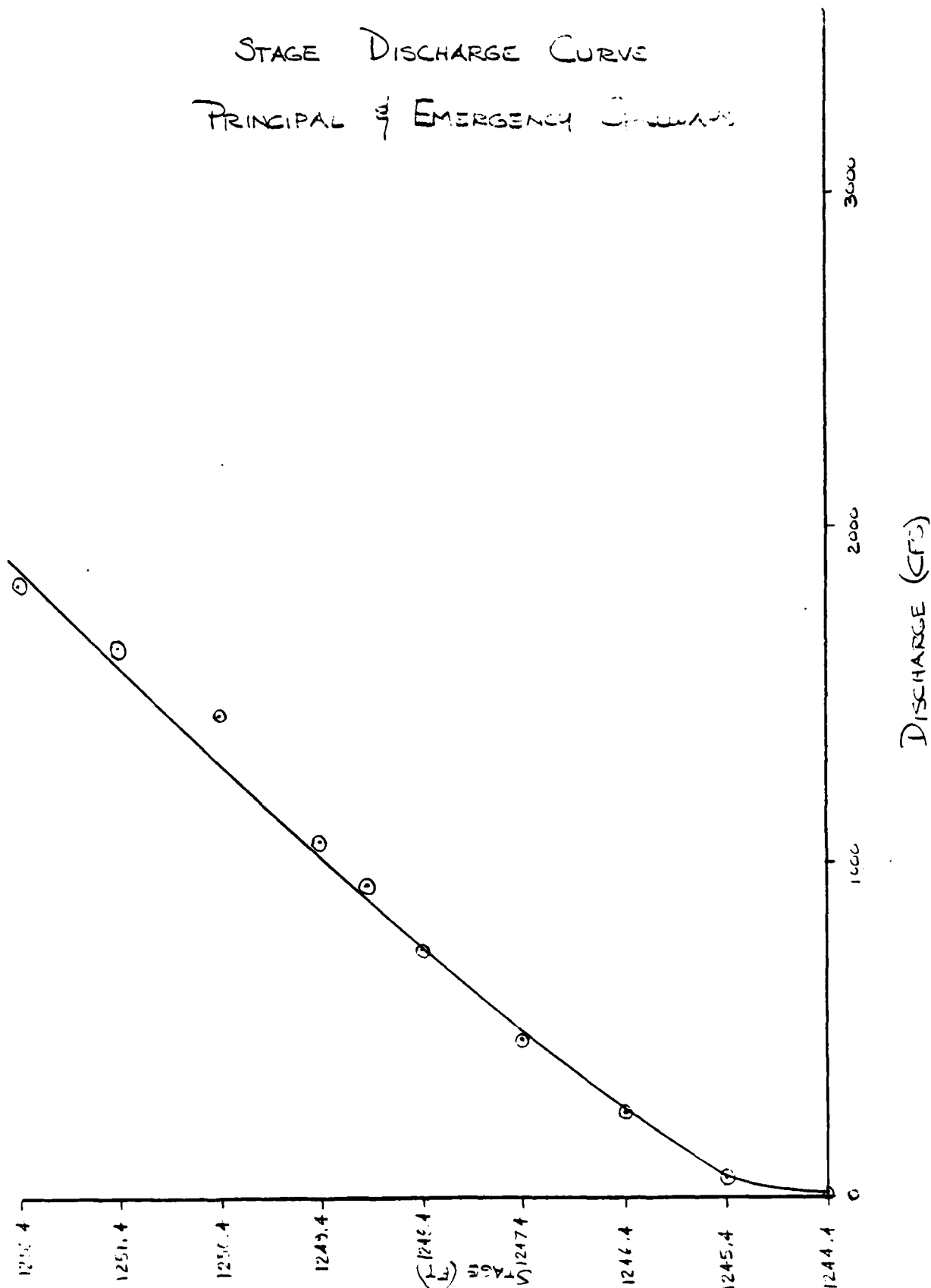
PROJECT NO 240  
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**FLAHERTY-GIAVARA ASSOCIATES**  
 ENVIRONMENTAL DESIGN CONSULTANTS  
 ONE COLUMBUS PLAZA, NEW HAVEN, CONN 06510/203/789-1280

SHEET NO. 13 OF 13  
 BY TLW DATE 4-2-81  
 CHK'D. BY TLW DATE 5-7-81

# STAGE DISCHARGE CURVE PRINCIPAL & EMERGENCY STAGINGS



HEC-1 FLOOD HYDROGRAPH COMPUTATIONS



NATIONAL DAM INSPECTION PROGRAM, PHASE I REPORT, COMPS OF ENGINEERS, NEW YORK DISTRICT  
 DAM INVENTORY NO. NY 349, NORWICH RESERVOIR NO. 2 DAM, CHENANGO COUNTY, NEW YORK, JUNE 27, 1981  
 PREPARED BY FLAHERTY GIAVARA ASSOCIATES, P.C., ONE COLUMBUS PLAZA, NEW HAVEN, CONNECTICUT

NG NHR NMIN IDAY IHR IMIN METRC IPLI IPHI NSTAN  
 120 0 30 0 0 0 0 2 0  
 JOVER 5 LROPT TRACE 0

## MULTI-PLAN ANALYSES TO BE PERFORMED

RTIOS= 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 1.00  
 NPLAN= 1 NRTIO= 9 LRTIO= 1

\*\*\*\*\* \*\*\*\*\* \*\*\*\*\* \*\*\*\*\* \*\*\*\*\*

## SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH, SUB-WATERSHED NO. 1, SNYDER METHOD  
 ISTAQ ICOMP IECON ITAPE JPLT JPRI INAME ISTAGE IAUTO  
 1 0 0 0 0 0 0 1 0 0

IHYDG IUNG TAKEA SNAP TRSDA TRSPC RATIO ISNOW ISAME LOCAL  
 1 1 2.09 0.00 3.78 1.00 0.000 0 1 0

## PRECIP DATA

BPFE PMS R6 R12 R24 R48 R72 R96  
 0.00 20.20 111.00 122.00 133.00 143.00 0.00 0.00

LOSS DATA  
 LROPT STRKR DLTKR RTIOL ERRAIN STRKS RTIOK STARTL CNSTL ALSHX RTIMP  
 0 0.00 0.00 1.00 0.00 0.00 1.00 1.00 0.10 0.00 0.01

UNIT HYDROGRAPH DATA  
 TP= 3.11 CP=0.63 NTA= 0

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 7.22 AND R= 5.49 INTERVALS  
 STRIQ= -2.00 GRCSN= -0.10 RTIOR= 1.50  
 RECESION DATA

UNIT HYDROGRAPH 33 END-OF-PERIOD ORDINATES, LAG= 3.09 HOURS, CP= 0.64 VCN= 1.00  
 16 60 119 103 183 230 271 278 254 213 178  
 148 123 103 86 14 11 10 49 41 34 29  
 24 16 3

END-OF-PERIOD FLOW  
 MU DA HR MIN PERIOD RAIN EXCS LOSS CUMP Q  
 1 01 0 30 1 0.01 0.00 0.01 4  
 1 01 1 00 2 0.01 0.00 0.01 4  
 1 01 1 30 3 0.01 0.00 0.01 4  
 1 01 2 00 4 0.01 0.00 0.01 4

LOSS LACS LACS CUMP Q  
 0.05 0.14 0.05 59  
 0.05 0.14 0.05 68  
 0.05 0.14 0.05 82  
 0.05 0.14 0.05 103



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( 734 ) ( 639 ) ( 94 ) ( 2025 11 )

TOTAL	VOLUME
71405	
2022	
26 48	
672 70	
2951	
3540	

72--HOUR  
595  
17  
26 48  
672 70  
2951  
3640.

24-HOUR  
1403  
40  
24 98  
634 62  
2784  
3433

6-1400R  
3616  
102  
16 09  
408 75  
1793  
2211

PF-AK  
4674  
132

CFS  
 CMS  
 INCHES  
 MM  
 AC-FT  
 THOUS CU M

✱ ۱۵۹ ✱

STATION 11

```
INFLOW(I), OUTFLOW(I) AND OBSERVED FLOW(*)
                                3000  4000  5000  0
```

```

PRECIP(L) AND EXCESS(X)
0 0 0 0
4 2 0 0

```

0 6

© 2000

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① ②

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[illegible]

C-23

[illegible]

[illegible]

1 + 1

C-25

STATION	HYDROGRAPH AT STA	1 FOR PLAN 1, RTID 4	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
2	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1
54	13	39	53	64	64	64	64
12	33	27	23	19	19	19	19
12	33	16	18	77	77	77	77
118	41	52	64	386	386	386	386
129	156	203	281	1775	1775	1775	1775
1553	1744	1855	1870	393	393	393	393
1317	633	938	459	151	151	151	151
1747	170	163	157	96	96	96	96
177	113	109	104	100	100	100	100
118							
	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME	
	1870	1446	561	238	2852	2852	
	53	41	16	7	809	809	
		6	9	10	59	10	59
		163	253	269	08	269	08
					1113	1180	
					1456	1456	

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
CL (MS)	137	1808	702	298		35702
IR (MS)	66	51	20	8		1011
IR (MS)		8	12	13		24
AC (T)		204	317	336		336
AC (T)		896	1392	1475		1475
AC (T)		1106	1171	1620		1620

	PLAY	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
(FS	2604	2169	842	357	42843	42843
UMS	79	61	10	10	1213	1213
IN PFS	9	55	14	15	15	89
M1		245	380	403	62	403
AL FT		1076	1670	1770	1770	1770
IN PFS		1327	2060	2184	2184	2184

[illegible]

C-27

个 体 学 习 与 研 究

## SUB - AREA RUNOFF COMPUTATION

[illegible]

HYDROGRAPH DATA		RATIO		ISNOW	ISAME	LOCAL
THYING	IUNG	TANEA	SNAP	TRSDA	TRSPC	
1	1	1.67	0.00	3.78	1.00	0
1	1	1.67	0.00	3.78	1.00	0

PRECIP DATA		R6	R12	R24	R48	R72	R96
SPFL	PMS	111.00	122.00	133.00	143.00	0.00	0.00
0.00	20.00						

LUSS DATA										
AMOPT	STRMR	LMVAR	RTIOK	ERRAIN	STKRS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.00	0.00	0.01

UNIT HYDROGRAPH DATA  
CP# 2 97 CP#0 63 NTA# 0

RECESSION DATA  
GRCSN= -0.1

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 6.80 AND R= 5.29 INTERVALS

UNIT	HYDROGRAPH	32	END-OF-PERIOD	ORDINATES.	LAG=	2	97	HOURS.	CP=	0.63	VOL=	1.00
13	53	100	165	211	234	230	201	166	137			
14	94	94	64	53	44	36	30	25	21			
17	14	15	10	8	7	5	5	4	3			

Q	HR	MIN	PERIOD	RATH	FLOW	END-OF-PERIOD CUMP G	MO	DA	HR	MIN	PERIOD	RAIN	EXCS	LOSS	COMP G
1	0	30	1	0	0	3	1	02	6	30	41	0	0	0	143
2	1	30	2	0	0	4	1	02	7	30	42	0	0	0	152
3	1	30	3	0	0	4	1	02	7	30	43	0	0	0	167
4	1	30	4	0	0	5	1	02	8	30	44	0	0	0	187
5	2	30	5	0	0	6	1	02	8	30	45	0	0	0	212
6	2	30	6	0	0	7	1	02	9	30	46	0	0	0	240
7	2	30	7	0	0	8	1	02	9	30	47	0	0	0	269
8	4	30	8	0	0	9	1	02	10	30	48	0	0	0	310
9	4	30	9	0	0	10	1	02	10	30	49	0	0	0	324
10	5	30	10	0	0	11	1	02	11	30	50	0	0	0	334
11	6	30	11	0	0	11	1	02	11	30	51	0	0	0	351
12	6	30	12	0	0	12	1	02	12	30	52	1	1	0	374
13	7	30	13	0	0	13	1	02	13	30	53	1	1	0	393
14	7	30	14	0	0	14	1	02	14	30	54	1	1	0	414
15	8	30	15	0	0	16	1	02	15	30	55	1	1	0	447
16	8	30	16	0	0	17	1	02	16	30	56	1	1	0	479
17	9	30	17	0	0	20	1	02	17	30	57	1	1	0	547
18	9	30	18	0	0	22	1	02	18	30	58	1	1	0	622
19	9	30	19	0	0	23	1	02	19	30	59	1	1	0	692
20	10	00	20	0	0	23	1	02	19	30	60	2	2	0	1916



0	700	1000	1500	2000	2500	3000	3500	4000	0	PRECIP(L) AND EXCESS(X)	0
1 01	10 30	21 30	01 07	00 00	25 30	1 02	17 30	30 00	57 00	00 00	2405
1 01	11 30	22 30	01 07	00 00	26 30	1 02	18 30	30 00	1 57	00 00	2490
1 01	12 30	23 30	01 08	00 00	27 30	1 02	19 30	30 00	1 23	00 00	2423
1 01	13 30	24 30	01 08	00 00	28 30	1 02	20 30	30 00	0 11	00 00	3800
1 01	14 30	25 30	01 10	00 00	29 30	1 02	21 30	30 00	0 11	00 00	3942
1 01	15 30	26 30	01 10	00 00	30 30	1 02	22 30	30 00	0 11	00 00	3679
1 01	16 30	27 30	01 13	00 00	31 30	1 02	23 30	30 00	0 11	00 00	3304
1 01	17 30	28 30	01 13	00 00	32 30	1 02	24 30	30 00	0 11	00 00	2898
1 01	18 30	29 30	01 15	00 00	33 30	1 02	25 30	30 00	0 11	00 00	2492
1 01	19 30	30 30	01 15	00 00	34 30	1 02	26 30	30 00	0 11	00 00	2116
1 01	20 30	31 30	01 15	00 00	35 30	1 02	27 30	30 00	0 11	00 00	1792
1 01	21 30	32 30	01 15	00 00	36 30	1 02	28 30	30 00	0 11	00 00	1524
1 01	22 30	33 30	01 15	00 00	37 30	1 02	29 30	30 00	0 11	00 00	1303
1 01	23 30	34 30	01 15	00 00	38 30	1 02	30 30	30 00	0 11	00 00	1119
1 01	24 30	35 30	01 15	00 00	39 30	1 03	31 30	30 00	0 00	00 00	967
1 01	25 30	36 30	01 15	00 00	40 30	1 03	32 30	30 00	0 00	00 00	840
1 01	26 30	37 30	01 15	00 00	41 30	1 03	33 30	30 00	0 00	00 00	730
1 01	27 30	38 30	01 15	00 00	42 30	1 03	34 30	30 00	0 00	00 00	632
1 01	28 30	39 30	01 15	00 00	43 30	1 03	35 30	30 00	0 00	00 00	543
1 01	29 30	40 30	01 15	00 00	44 30	1 03	36 30	30 00	0 00	00 00	461
1 01	30 30	41 30	01 15	00 00	45 30	1 03	37 30	30 00	0 00	00 00	386
1 01	31 30	42 30	01 15	00 00	46 30	1 03	38 30	30 00	0 00	00 00	355
1 01	32 30	43 30	01 15	00 00	47 30	1 03	39 30	30 00	0 00	00 00	331
1 01	33 30	44 30	01 15	00 00	48 30	1 03	40 30	30 00	0 00	00 00	323
1 02	34 30	45 30	01 15	00 00	49 30	1 03	41 30	30 00	0 00	00 00	311
1 02	35 30	46 30	01 15	00 00	50 30	1 03	42 30	30 00	0 00	00 00	298
1 02	36 30	47 30	01 15	00 00	51 30	1 03	43 30	30 00	0 00	00 00	279
1 02	37 30	48 30	01 15	00 00	52 30	1 03	44 30	30 00	0 00	00 00	264
1 02	38 30	49 30	01 15	00 00	53 30	1 03	45 30	30 00	0 00	00 00	254
1 02	39 30	50 30	01 15	00 00	54 30	1 03	46 30	30 00	0 00	00 00	243
1 02	40 30	51 30	01 15	00 00	55 30	1 03	47 30	30 00	0 00	00 00	235
1 02	41 30	52 30	01 15	00 00	56 30	1 03	48 30	30 00	0 00	00 00	216
1 02	42 30	53 30	01 15	00 00	57 30	1 03	49 30	30 00	0 00	00 00	207
1 02	43 30	54 30	01 15	00 00	58 30	1 03	50 30	30 00	0 00	00 00	199
1 02	44 30	55 30	01 15	00 00	59 30	1 03	51 30	30 00	0 00	00 00	191
1 02	45 30	56 30	01 15	00 00	60 30	1 03	52 30	30 00	0 00	00 00	66120
1 02	46 30	57 30	01 15	00 00	61 30	1 03	53 30	30 00	0 00	00 00	1872 31
1 02	47 30	58 30	01 15	00 00	62 30	1 03	54 30	30 00	0 00	00 00	
1 02	48 30	59 30	01 15	00 00	63 30	1 03	55 30	30 00	0 00	00 00	
1 02	49 30	60 30	01 15	00 00	64 30	1 03	56 30	30 00	0 00	00 00	
1 02	50 30	61 30	01 15	00 00	65 30	1 03	57 30	30 00	0 00	00 00	
1 02	51 30	62 30	01 15	00 00	66 30	1 03	58 30	30 00	0 00	00 00	
1 02	52 30	63 30	01 15	00 00	67 30	1 03	59 30	30 00	0 00	00 00	
1 02	53 30	64 30	01 15	00 00	68 30	1 03	60 30	30 00	0 00	00 00	
1 02	54 30	65 30	01 15	00 00	69 30	1 03	61 30	30 00	0 00	00 00	
1 02	55 30	66 30	01 15	00 00	70 30	1 03	62 30	30 00	0 00	00 00	
1 02	56 30	67 30	01 15	00 00	71 30	1 03	63 30	30 00	0 00	00 00	
1 02	57 30	68 30	01 15	00 00	72 30	1 03	64 30	30 00	0 00	00 00	
1 02	58 30	69 30	01 15	00 00	73 30	1 03	65 30	30 00	0 00	00 00	
1 02	59 30	70 30	01 15	00 00	74 30	1 03	66 30	30 00	0 00	00 00	
1 02	60 30	71 30	01 15	00 00	75 30	1 03	67 30	30 00	0 00	00 00	
1 02	61 30	72 30	01 15	00 00	76 30	1 03	68 30	30 00	0 00	00 00	
1 02	62 30	73 30	01 15	00 00	77 30	1 03	69 30	30 00	0 00	00 00	
1 02	63 30	74 30	01 15	00 00	78 30	1 03	70 30	30 00	0 00	00 00	
1 02	64 30	75 30	01 15	00 00	79 30	1 03	71 30	30 00	0 00	00 00	
1 02	65 30	76 30	01 15	00 00	80 30	1 03	72 30	30 00	0 00	00 00	
1 02	66 30	77 30	01 15	00 00	81 30	1 03	73 30	30 00	0 00	00 00	
1 02	67 30	78 30	01 15	00 00	82 30	1 03	74 30	30 00	0 00	00 00	
1 02	68 30	79 30	01 15	00 00	83 30	1 03	75 30	30 00	0 00	00 00	
1 02	69 30	80 30	01 15	00 00	84 30	1 03	76 30	30 00	0 00	00 00	
1 02	70 30	81 30	01 15	00 00	85 30	1 03	77 30	30 00	0 00	00 00	
1 02	71 30	82 30	01 15	00 00	86 30	1 03	78 30	30 00	0 00	00 00	
1 02	72 30	83 30	01 15	00 00	87 30	1 03	79 30	30 00	0 00	00 00	
1 02	73 30	84 30	01 15	00 00	88 30	1 03	80 30	30 00	0 00	00 00	
1 02	74 30	85 30	01 15	00 00	89 30	1 03	81 30	30 00	0 00	00 00	
1 02	75 30	86 30	01 15	00 00	90 30	1 03	82 30	30 00	0 00	00 00	
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1 02	81 30	92 30	01 15	00 00	96 30	1 03	88 30	30 00	0 00	00 00	
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1 02	84 30	95 30	01 15	00 00	99 30	1 03	91 30	30 00	0 00	00 00	
1 02	85 30	96 30	01 15	00 00	100 30	1 03	92 30	30 00	0 00	00 00	
1 02	86 30	97 30	01 15	00 00	101 30	1 03	93 30	30 00	0 00	00 00	
1 02	87 30	98 30	01 15	00 00	102 30	1 03	94 30	30 00	0 00	00 00	
1 02	88 30	99 30	01 15	00 00	103 30	1 03	95 30	30 00	0 00	00 00	
1 02	89 30	100 30	01 15	00 00	104 30	1 03	96 30	30 00	0 00	00 00	
1 02	90 30	101 30	01 15	00 00	105 30	1 03	97 30	30 00	0 00	00 00	
1 02	91 30	102 30	01 15	00 00	106 30	1 03	98 30	30 00	0 00	00 00	
1 02	92 30	103 30	01 15	00 00	107 30	1 03	99 30	30 00	0 00	00 00	
1 02	93 30	104 30	01 15	00 00	108 30	1 03	100 30	30 00	0 00	00 00	
1 02	94 30	105 30	01 15	00 00	109 30	1 03	101 30	30 00	0 00	00 00	
1 02	95 30	106 30	01 15	00 00	110 30	1 03	102 30	30 00	0 00	00 00	
1 02	96 30	107 30	01 15	00 00	111 30	1 03	103 30	30 00	0 00	00 00	
1 02	97 30	108 30	01 15	00 00	112 30	1 03	104 30	30 00	0 00	00 00	
1 02	98 30	109 30	01 15	00 00	113 30	1 03	105 30	30 00	0 00	00 00	
1 02	99 30	110 30	01 15	00 00	114 30	1 03	106 30	30 00	0 00	00 00	
1 02	100 30	111 30	01 15	00 00	115 30	1 03	107 30	30 00	0 00	00 00	
1 02	101 30	112 30	01 15	00 00	116 30	1 03	108 30	30 00	0 00	00 00	
1 02	102 30	113 30	01 15	00 00	117 30	1 03	109 30	30 00	0 00	00 00	
1 02	103 30	114 30	01 15	00 00	118 30	1 03	110 30	30 00	0 00	00 00	
1 02	104 30	115 30	01 15	00 00	119 30	1 03	111 30	30 00	0 00	00 00	
1 02	105 30	116 30	01 15	00 00	120 30	1 03	112 30	30 00	0 00	00 00	
1 02	106 30	117 30	01 15	00 00	121 30	1 03	113 30	30 00	0 00	00 00	
1 02	107 30	118 30	01 15	00 00	122 30	1 03	114 30	30 00	0 00	00 00	
1 02	108 30	119 30	01 15	00 00	123 30	1 03	115 30	30 00	0 00	00 00	
1 02	109 30	120 30	01 15	00 00	124 30	1 03	116 30	30 00	0 00	00 00	
1 02	110 30	121 30	01 15	00 00	125 30	1 03	117 30	30 00	0 00	00 00	
1 02	111 30	122 30	01 15	00 00	126 30	1 03	118 30	30 00	0 00		

FLAHERTY GIAVARA ASSOCIATES, P C

C-30

FLAHERTY GIAVARA ASSOCIATES, P C

[illegible]

C-31

10 00116 1  
11 00117 1  
12 00118 1  
13 00119 1  
14 00120 1

1-00000

STATION	PLAN	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
1	377	307	122	55	55	6602
2	11	9	2	3	3	187
3		1 69	2 69	3 03	3 03	3 03
4		42 91	68 20	76 92	76 92	76 92
5		122	242	273	273	273
6		188	298	337	337	337
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VOLUME

STATION	PLAN	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
1	377	307	122	55	55	6602
2	11	9	2	3	3	187
3		1 69	2 69	3 03	3 03	3 03
4		42 91	68 20	76 92	76 92	76 92
5		122	242	273	273	273
6		188	298	337	337	337
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VOLUME

STATION	PLAN	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
1	377	307	122	55	55	6602
2	11	9	2	3	3	187
3		1 69	2 69	3 03	3 03	3 03
4		42 91	68 20	76 92	76 92	76 92
5		122	242	273	273	273
6		188	298	337	337	337
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PLAN  
6-HOUR  
24-HOUR  
72-HOUR  
TOTAL  
VOLUME

3	4	5	6	7
37	43	50	56	62
35	41	48	54	60
32	38	44	50	56
29	35	41	47	53
26	32	38	44	50
23	29	35	41	47
20	26	32	38	44
18	24	30	36	42
15	21	27	33	39
12	18	24	30	36
10	16	22	28	34
8	14	20	26	32
6	12	18	24	30
4	10	16	22	28
3	9	15	21	27
2	8	14	20	26
1	7	13	19	25
0	6	12	18	24
0	5	11	17	23
0	4	10	16	22
0	3	9	15	21
0	2	8	14	20
0	1	7	13	19
0	0	6	12	18
0	0	5	11	17
0	0	4	10	16
0	0	3	9	15
0	0	2	8	14
0	0	1	7	13
0	0	0	6	12
0	0	0	5	11
0	0	0	4	10
0	0	0	3	9
0	0	0	2	8
0	0	0	1	7
0	0	0	0	6
0	0	0	0	5
0	0	0	0	4
0	0	0	0	3
0	0	0	0	2
0	0	0	0	1
0	0	0	0	0

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
1196	921	366	163	1986	1986
34	26	10	3	561	561
	5 07	8 06	9 08	230 76	230 76
	128 73	204 61	818	1010	1010
	457	726	1010		
	563	895			

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 4

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020	1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040	1041	1042	1043	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056	1057	1058	1059	1060	1061	1062	1063	1064	1065	1066	1067	1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	1080	1081	1082	1083	1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117	1118	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140	1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161	1162	1163	1164	1165	1166	1167	1168	1169	1170	1171	1172	1173	1174	1175	1176	1177	1178	1179	1180	1181	1182	1183	1184	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199	1200	1201	1202	1203	1204	1205	1206	1207	1208	1209	1210	1211	1212	1213	1214	1215	1216	1217	1218	1219	1220	1221	12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FLAHERTY GIAVARA ASSOCIATES, P. C.

THOUS CU M	AC-FT	INCHES	CFS	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
2	174	56	194	1532	610	273	33010	6	
7	147	43	147	17	17	8	935	14	
13	131	36	131	843	1343	1514	1514	36	
37	86	214	214	341	341	384	384	82	
84	204	741	741	1209	1209	1364	1364	196	
204	1443	939	939	1492	1492	1683	1683	1150	
1443	1249							1495	
1249	276							326	
276	165							172	
165								119	

6	6
14	13
56	43
149	166
36	39
82	79
196	186
1150	919
1495	1739
326	379
172	179
119	119

HYDROGRAPH AT STA	4	1 FOR PLAN 1.	RTID
3	4	4	5
17	8	9	10
131	18	20	125
49	122	172	180
69	159	219	211
60	149	144	172
40	127	144	160
112	140	144	160
260	329	430	2307
2280	2593	2365	2304
782	672	3808	194
219	210	202	119
38	210	202	119

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
CFS	2393	1841	732	330		39612
CHS	68	52	21	9		1122
INCHES		10 14	40 21	18 17		18 17
MM		257 46	409 21	461 51		461 51
AC-FT		1431	1431	1637		1637
		1126	1790	2019		2019

	2	7	12	17	22	27	32	37	42	47	52	57	62	67	72	77	82	87	92	97	102	107	112	117	122	127	132	137	142	147	152	157	162	167	172	177	182	187	192	197	202	207	212	217	222	227	232	237	242	247	252	257	262	267	272	277	282	287	292	297	302	307	312	317	322	327	332	337	342	347	352	357	362	367	372	377	382	387	392	397	402	407	412	417	422	427	432	437	442	447	452	457	462	467	472	477	482	487	492	497	502	507	512	517	522	527	532	537	542	547	552	557	562	567	572	577	582	587	592	597	602	607	612	617	622	627	632	637	642	647	652	657	662	667	672	677	682	687	692	697	702	707	712	717	722	727	732	737	742	747	752	757	762	767	772	777	782	787	792	797	802	807	812	817	822	827	832	837	842	847	852	857	862	867	872	877	882	887	892	897	902	907	912	917	922	927	932	937	942	947	952	957	962	967	972	977	982	987	992	997	1002	1007	1012	1017	1022	1027	1032	1037	1042	1047	1052	1057	1062	1067	1072	1077	1082	1087	1092	1097	1102	1107	1112	1117	1122	1127	1132	1137	1142	1147	1152	1157	1162	1167	1172	1177	1182	1187	1192	1197	1202	1207	1212	1217	1222	1227	1232	1237	1242	1247	1252	1257	1262	1267	1272	1277	1282	1287	1292	1297	1302	1307	1312	1317	1322	1327	1332	1337	1342	1347	1352	1357	1362	1367	1372	1377	1382	1387	1392	1397	1402	1407	1412	1417	1422	1427	1432	1437	1442	1447	1452	1457	1462	1467	1472	1477	1482	1487	1492	1497	1502	1507	1512	1517	1522	1527	1532	1537	1542	1547	1552	1557	1562	1567	1572	1577	1582	1587	1592	1597	1602	1607	1612	1617	1622	1627	1632	1637	1642	1647	1652	1657	1662	1667	1672	1677	1682	1687	1692	1697	1702	1707	1712	1717	1722	1727	1732	1737	1742	1747	1752	1757	1762	1767	1772	1777	1782	1787	1792	1797	1802	1807	1812	1817	1822	1827	1832	1837	1842	1847	1852	1857	1862	1867	1872	1877	1882	1887	1892	1897	1902	1907	1912	1917	1922	1927	1932	1937	1942	1947	1952	1957	1962	1967	1972	1977	1982	1987	1992	1997	2002	2007	2012	2017	2022	2027	2032	2037	2042	2047	2052	2057	2062	2067	2072	2077	2082	2087	2092	2097	2102	2107	2112	2117	2122	2127	2132	2137	2142	2147	2152	2157	2162	2167	2172	2177	2182	2187	2192	2197	2202	2207	2212	2217	2222	2227	2232	2237	2242	2247	2252	2257	2262	2267	2272	2277	2282	2287	2292	2297	2302	2307	2312	2317	2322	2327	2332	2337	2342	2347	2352	2357	2362	2367	2372	2377	2382	2387	2392	2397	2402	2407	2412	2417	2422	2427	2432	2437	2442	2447	2452	2457	2462	2467	2472	2477	2482	2487	2492	2497	2502	2507	2512	2517	2522	2527	2532	2537	2542	2547	2552	2557	2562	2567	2572	2577	2582	2587	2592	2597	2602	2607	2612	2617	2622	2627	2632	2637	2642	2647	2652	2657	2662	2667	2672	2677	2682	2687	2692	2697	2702	2707	2712	2717	2722	2727	2732	2737	2742	2747	2752	2757	2762	2767	2772	2777	2782	2787	2792	2797	2802	2807	2812	2817	2822	2827	2832	2837	2842	2847	2852	2857	2862	2867	2872	2877	2882	2887	2892	2897	2902	2907	2912	2917	2922	2927	2932	2937	2942	2947	2952	2957	2962	2967	2972	2977	2982	2987	2992	2997	3002	3007	3012	3017	3022	3027	3032	3037	3042	3047	3052	3057	3062	3067	3072	3077	3082	3087	3092	3097	3102	3107	3112	3117	3122	3127	3132	3137	3142	3147	3152	3157	3162	3167	3172	3177	3182	3187	3192	3197	3202	3207	3212	3217	3222	3227	3232	3237	3242	3247	3252	3257	3262	3267	3272	3277	3282	3287	3292	3297	3302	3307	3312	3317	3322	3327	3332	3337	3342	3347	3352	3357	3362	3367	3372	3377	3382	3387	3392	3397	3402	3407	3412	3417	3422	3427	3432	3437	3442	3447	3452	3457	3462	3467	3472	3477	3482	3487	3492	3497	3502	3507	3512	3517	3522	3527	3532	3537	3542	3547	3552	3557	3562	3567	3572	3577	3582	3587	3592	3597	3602	3607	3612	3617	3622	3627	3632	3637	3642	3647	3652	3657	3662	3667	3672	3677	3682	3687	3692	3697	3702	3707	3712	3717	3722	3727	3732	3737	3742	3747	3752	3757	3762	3767	3772	3777	3782	3787	3792	3797	3802	3807	3812	3817	3822	3827	3832	3837	3842	3847	3852	3857	3862	3867	3872	3877	3882	3887	3892	3897	3902	3907	3912	3917	3922	3927	3932	3937	3942	3947	3952	3957	3962	3967	3972	3977	3982	3987	3992	3997	4002	4007	4012	4017	4022	4027	4032	4037	4042	4047	4052	4057	4062	4067	4072	4077	4082	4087	4092	4097	4102	4107	4112	4117	4122	4127	4132	4137	4142	4147	4152	4157	4162	4167	4172	4177	4182	4187	4192	4197	4202	4207	4212	4217	4222	4227	4232	4237	4242	4247	4252	4257	4262	4267	4272	4277	4282	4287	4292	4297	4302	4307	4312	4317	4322	4327	4332	4337	4342	4347	4352	4357	4362	4367	4372	4377	4382	4387	4392	4397	4402	4407	4412	4417	4422	4427	4432	4437	4442	4447	4452	4457	4462	4467	4472	4477	4482	4487	4492	4497	4502	4507	4512	4517	4522	4527	4532	4537	4542	4547	4552	4557	4562	4567	4572	4577	4582	4587	4592	4597	4602	4607	4612	4617	4622	4627	4632	4637	4642	4647	4652	4657	4662	4667	4672	4677	4682	4687	4692	4697	4702	4707	4712	4717	4722	4727	4732	4737	4742	4747	4752	4757	4762	4767	4772	4777	4782	4787	4792	4797	4802	4807	4812	4817	4822	4827	4832	4837	4842	4847	4852	4857	4862	4867	4872	4877	4882	4887	4892	4897	4902	4907	4912	4917	4922	4927	4932	4937	4942	4947	4952	4957	4962	4967	4972	4977	4982	4987	4992	4997	5002	5007	5012	5017	5022	5027	5032	5037	5042	5047	5052	5057	5062	5067	5072	5077	5082	5087	5092	5097	5102	5107	5112	5117	5122	5127	5132	5137	5142	5147	5152	5157	5162	5167	5172	5177	5182	5187	5192	5197	5202	5207	5212	5217	5222	5227	5232	5237	5242	5247	5252	5257	5262	5267	5272	5277	5282	5287	5292	5297	5302	5307	5312	5317	5322	5327	5332	5337	5342	5347	5352	5357	5362	5367	5372	5377	5382	5387	5392	5397	5402	5407	5412	5417	5422	5427	5432	5437	5442	5447	5452	5457	5462	5467	5472	5477	5482	5487	5492	5497	5502	5507	5512	5517	5522	5527	5532	5537	5542	5547	5552	5557	5562	5567	5572	5577	5582	5587	5592	5597	5602	5607	5612	5617	5622	5627	5632	5637	5642	5647	5652	5657	5662	5667	5672	5677	5682	5687	5692	5697	5702	5707	5712	5717	5722	5727	5732	5737	5742	5747	5752	5757	5762	5767	5772	5777	5782	5787	5792	5797	5802	5807	5812	5817	5822	5827	5832	5837	5842	5847	5852	5857	5862	5867	5872	5877	5882	5887	5892	5897	5902	5907	5912	5917	5922	5927	5932	5937	5942	5947	5952	5957	5962	5967	5972	5977	5982	5987	5992	5997	6002	6007	6012	6017	6022	6027	6032	6037	6042	6047	6052	6057	6062	6067	6072	6077	6082	6087	6092	6097	6102	6107	6112	6117	6122	6127	6132	6137	6142	6147	6152	6157	6162	6167	6172	6177	6182	6187	6192	6197	6202	6207	6212	6217	6222	6227	6232	6237	6242	6247	6252	6257	6262	6267	6272	6277	6282	6287	6292	6297	6302	6307	6312	6317	6322	6327	6332	6337	6342	6347	6352	6357	6362	6367	6372	6377	6382	6387	6392	6397	6402	6407	6412	6417	6422	6427	6432	6437	6442	6447	6452	6457	6462	6467	6472	6477	6482	6487	6492	6497	6502	6507	6512	6517	6522	6527	6532	6537	6542	6547	6552	6557	6562	6567	6572	6577	6582	6587	6592	6597	6602	6607	6612	6617	6622	6627	6632	6637	6642	6647	6652	6657	6662	6667	6672	6677	6682	6687	6692	6697	6702	6707	6712	6717	6722	6727	6732	6737	6742	6747	6752	6757	6762	6767	6772	6777	6782	6787	6792	6797	6802	6807	6812	6817	6822	6827	6832	6837	6842	6847	6852	6857	6862	6867	6872	6877	6882	6887	6892	6897	6902	6907	6912	6917	6922	6927	6932	6937	6942	6947	6952	6957	6962	6967	6972	6977	6982	6987	6992	6997</
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HYDROGRAPH AT STA				1 FOR PLAN 1. RTIO			
3	2	4	5	6	7	8	9
3	9	10	11	12	13	14	15
4	17	21	24	29	34	39	44
19	159	181	209	210	239	269	299
27	45	81	69	59	83	83	83
33	61	70	77	83	83	83	83
33	131	149	168	187	187	187	187
62	303	381	501	663	663	663	663
96	2660	2791	2759	2575	2575	2575	2575
67	912	783	677	588	588	588	588
256	245	245	236	226	226	226	226
66	170	164	157	151	151	151	151
77							

HYDROGRAPH AT STA				1 FOR PLAN 1. RTIO			
3	2	4	5	6	7	8	9
3	4	5	6	7	8	9	10
3	10	11	12	13	14	15	16
4	17	21	24	29	34	39	44
19	159	181	209	210	239	269	299
27	45	81	69	59	83	83	83
33	61	70	77	83	83	83	83
33	131	149	168	187	187	187	187
62	303	381	501	663	663	663	663
96	2660	2791	2759	2575	2575	2575	2575
67	912	783	677	588	588	588	588
256	245	245	236	226	226	226	226
66	170	164	157	151	151	151	151
77							

THOUS CU M	AC-FT	INCHES	CFS	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
2	174	56	194	1532	610	273	33010	6	
7	147	43	147	17	17	8	935	14	
13	131	36	131	843	1343	1514	1514	36	
37	86	214	214	341	341	384	384	82	
84	204	741	741	1209	1209	1364	1364	196	
204	1443	939	939	1492	1492	1683	1683	1150	
1443	1249							1495	
1249	276							326	
276	165							172	
165								119	

HYDROGRAPH AT STA		1 FOR PLAN 1. RTIO	
3	4	5	7
10	10	11	14
		12	14

20	21	22	23	27	34	44	58	74
93	145	177	207	229	240	238	222	199
173	128	108	92	79	68	59	52	48
49	61	150	80	88	95	101	106	110
114	134	150	170	192	214	232	248	261
122	150	170	192	214	232	248	261	1533
281	346	433	573	757	980	1225	1533	1994
2344	2739	3040	3190	374	2973	2643	2318	434
1924	1219	1042	873	287	642	594	506	229
1692	304	292	281	180	252	248	239	153
369	203	195	187	172	172	159	159	
220								

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
3190	2455	976	440	3281	52816
90	70	28	12	1496	1496
	13 51	21 48	24 23	615 35	615 35
	343 27	545 62	615 35	2182	2182
	1217	1935	2692	2692	2692
	1502	2387			

HYDROGRAPH AT STA 1 FOR PLAN 1. RTIO 9

3	4	5	6	7	8	9	10	11
11	12	13	14	16	17	20	22	23
122	27	28	29	34	42	55	72	93
116	182	221	258	286	301	297	277	249
219	170	135	115	98	85	73	65	61
61	189	188	100	110	119	126	132	137
143	167	187	212	240	267	290	310	326
351	374	433	544	716	947	1225	1532	1916
2930	3423	3800	3988	3942	3679	3304	2898	2492
2405	1524	1303	1119	967	840	730	632	543
2116	380	363	321	337	323	311	298	286
461	254	243	234	225	216	207	199	191
275								

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
3988	3057	1220	550	6020	6020
113	87	35	16	1869	1869
	16 89	26 85	30 28	30 28	30 28
	429 09	682 03	767 19	767 19	767 19
	1522	2419	2728	2728	2728
	1877	2984	3365	3365	3365

\*\*\*\*\*

COMBINE HYDROGRAPHS

INFLW HYDROGRAPHS	SUB-WATERSHEDS NO 1 & NO 2 COMBINED	INAME	ISTAGE	IAUTO
ISTAG	ICOMP	IECON	JPLT	JPT
1	2	0	0	0

1	1	1	1	1
1	1	1	1	1
3	3	3	3	3

12	16	21	28	36	42	46	47	45	40
35	30	23	22	18	16	13	11	10	9
9	10	11	12	14	15	17	18	19	19
20	22	25	29	34	40	46	51	55	59
62	65	70	82	106	142	191	251	318	402
508	622	731	816	863	862	812	733	643	557
473	400	339	288	246	212	182	157	135	116
98	86	62	79	76	73	70	67	63	62
59	57	55	53	51	49	47	45	43	41

PEAK  
853  
24

CFS  
CMS  
INCHES  
AC FT  
THOUS CU M

6-HOUR 668  
24-HOUR 262  
72-HOUR 112  
TOTAL VOLUME 13742

668  
262  
112  
13742

668  
262  
112  
13742

1\*OVF\*

STATION 1

INFLOW (1), OUTFLOW (2) AND OBSERVED FLOW (\*)

	100	200	300	400	500	600	700	800	900	0
0	11	12	11	11	11	11	11	11	11	0
1	30	31	31	31	31	31	31	31	31	0
2	11	30	41	51	61	71	81	91	101	0
3	12	30	51	61	71	81	91	101	111	0
4	30	30	61	71	81	91	101	111	121	0
5	40	30	71	81	91	101	111	121	131	0
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8	70	30	101	111	121	131	141	151	161	0
9	80	30	111	121	131	141	151	161	171	0
10	90	30	121	131	141	151	161	171	181	0
11	100	30	131	141	151	161	171	181	191	0
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14	130	30	161	171	181	191	201	211	221	0
15	140	30	171	181	191	201	211	221	231	0
16	150	30	181	191	201	211	221	231	241	0
17	160	30	191	201	211	221	231	241	251	0
18	170	30	201	211	221	231	241	251	261	0
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26	250	30	281	291	301	311	321	331	341	0
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84	830	30	861	871	881	891	901	911	921	0
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FLAHERTY GIAVARA ASSOCIATES. P C

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STATION 11

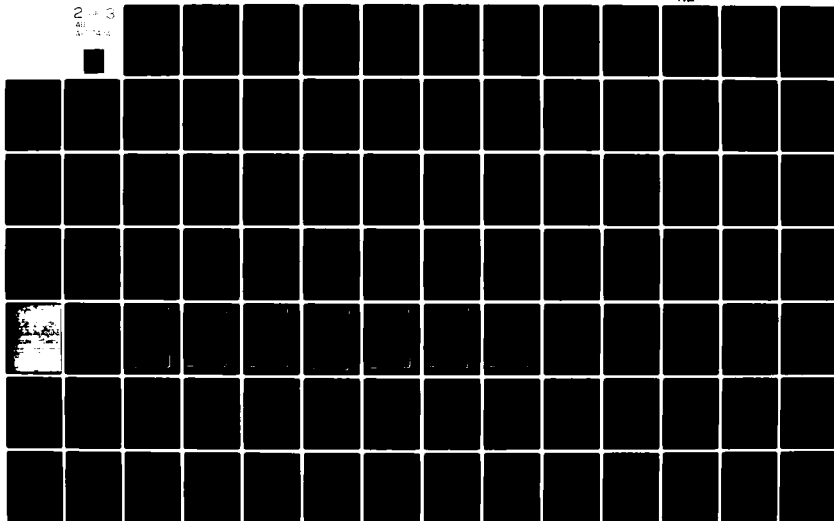
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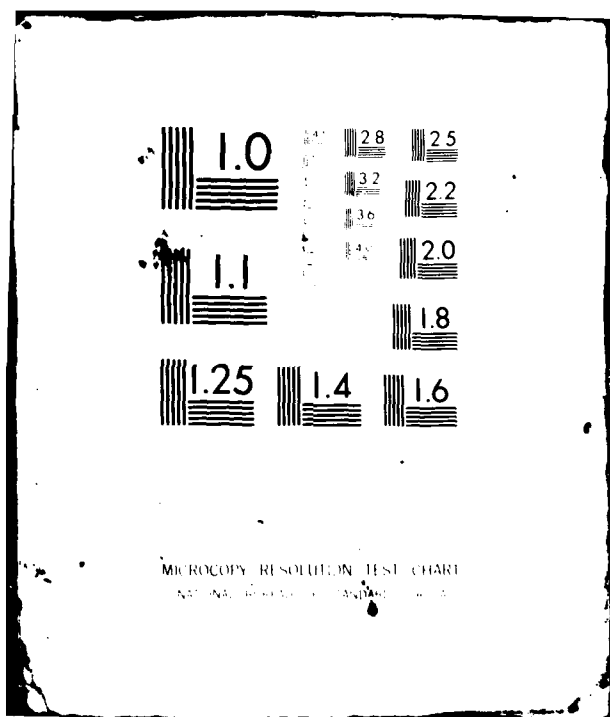
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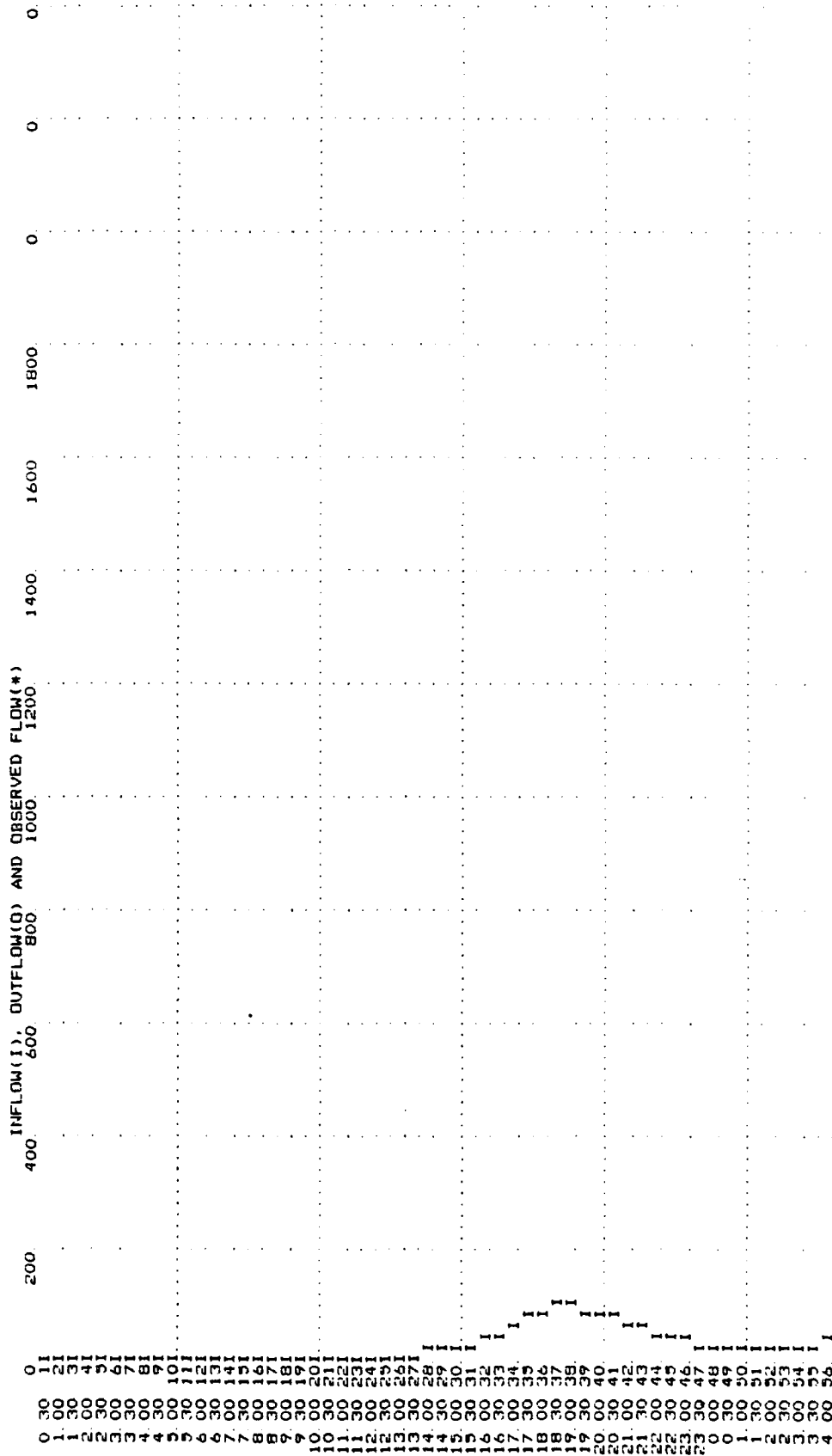
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2 of 3  
ALL INFORMATION CONTAINED  
HEREIN IS UNCLASSIFIED







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FLAHERTY GIAVARA ASSOCIATES, P C

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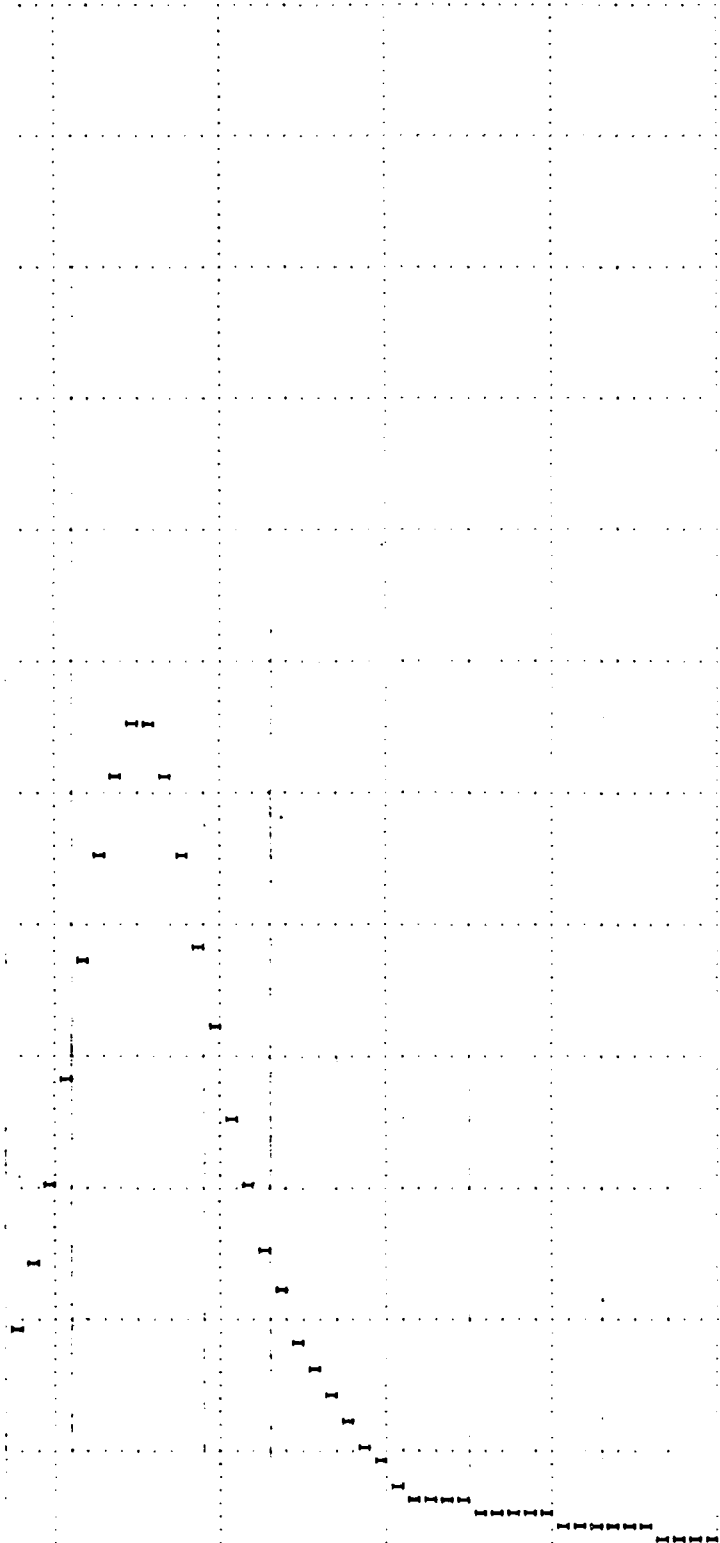
PAGE 0024

FLAHERTY GIAVARA ASSOCIATES, P C

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50 00 113  
51 00 114  
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54 00 117  
55 00 118  
56 00 119  
57 00 120



1\*OVN\*

SUM OF 2 HYDROGRAPHS AT		PLAN 1		RTIO 4	
3	4	4	5	5	5
3	3	7	8	9	10
11	12	14	18	30	38
62	142	168	184	179	162
122	173	62	53	39	36
38	49	62	67	74	77
88	116	160	184	222	236
259	329	568	764	1271	1608

\*\*\*\*\*

RUN DATE 6/27/  
TIME 3 01 PM

	2489	2922	3264	3450	3446	3247	2930	2226
2033		2922	3264	3450	3446	3247	2930	2581
1892	1400	1356	1154	986	846	729	629	541
393	343	329	316	303	291	280	248	238
238	229	219	211	202	194	187	179	165
		PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME	
		3450	2674	1048	458	3470		
		98	30	13	157			
			6.58	10.32	11.27			
	INCHES		167.14	262.14	286.34			
	MM							
	AC-FT							
	THOUS CU M							
			1635	2585	2802			

**# 100%**

STATION 1

INFLOW(I),	OUTFLOW(O)	AND OBSERVED FLOW(*)
1200	1600.	2000.
		2400.

Time Step	Inflow (17)	Outflow (17)	Observed Flow (17)
1	100	100	100
2	100	100	100
3	100	100	100
4	100	100	100
5	100	100	100
6	100	100	100
7	100	100	100
8	100	100	100
9	100	100	100
10	100	100	100
11	100	100	100
12	100	100	100
13	100	100	100
14	100	100	100
15	100	100	100
16	100	100	100
17	100	100	100
18	100	100	100
19	100	100	100
20	100	100	100
21	100	100	100
22	100	100	100
23	100	100	100
24	100	100	100
25	100	100	100
26	100	100	100
27	100	100	100
28	100	100	100
29	100	100	100
30	100	100	100
31	100	100	100
32	100	100	100
33	100	100	100
34	100	100	100
35	100	100	100
36	100	100	100
37	100	100	100
38	100	100	100
39	100	100	100
40	100	100	200

FLAHERTY GIAVARA ASSOCIATES, P C

20 30 41  
21 30 42  
22 30 43  
23 30 44  
24 30 45  
25 30 46  
26 30 47  
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1 30 99  
2 00100  
3 00101  
4 00102  
5 00103  
6 00104  
7 00105  
8 00106  
9 00107  
10 00108  
11 00109  
12 00110  
13 00111  
14 00112  
15 00113  
16 00114  
17 00115  
18 00116  
19 00117  
20 00118  
21 00119  
22 00120

1\*OVH\*

4	7	14	17	152	148	110	323	311	2342	428	286	4	7	13	59	177	45	101	2342	2365	471	297	
SUM OF 2 HYDROGRAPHS AT												PLAN 1											
4												5											
4												6											
7												7											
14												18											
106												210											
177												78											
54												77											
124												64											
101												89											
348												229											
141												277											
4080												1589											
3653												3236											
1695												3986											
1411												711											
274												224											
263												230											
263												253											
6-HOUR												72-HOUR											
3342												573											
1311												16											
37												14											
12												09											
8												23											
208												92											
92												357											
208												92											
1657												2839											
2044												3502											
PEAK												TOTAL											
4313												68712											
122												1946											
CFS												VOLUME											
CMS												14469											
INCHES												357											
MM												92											
AC-FT												2839											
THOUS CU M												3502											

STATION 1

IN FLOW (I), OUTFLOW (O) AND OBSERVED FLOW (F)

0 30 11  
1 00 21  
1 30 31

1\*OVF\*

400

3600

4000

4400

0

41  
51  
61  
71  
81  
91  
101  
111  
121  
131  
141  
151  
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171  
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611

7 00 62  
7 30 63  
8 00 64  
8 30 65  
9 00 66  
9 30 67  
10 00 68  
10 30 69  
11 00 70  
11 30 71  
12 00 72  
12 30 73  
13 00 74  
13 30 75  
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24 30 97  
25 00 98  
25 30 99  
26 00 00  
26 30 01  
27 00 02  
27 30 03  
28 00 04  
28 30 05  
29 00 06  
29 30 07  
30 00 08  
30 30 09  
31 00 10  
31 30 11  
32 00 12  
32 30 13  
33 00 14  
33 30 15  
34 00 16  
34 30 17  
35 00 18  
35 30 19



ELI AHERTY GIVARA ASSOCIATES, P C

[illegible]



17	30	63
18	30	64
19	30	65
20	30	66
21	30	67
22	30	68
23	30	69
24	30	70
25	30	71
26	30	72
27	30	73
28	30	74
29	30	75
30	30	76
31	30	77
32	30	78
33	30	79
34	30	80
35	30	81
36	30	82
37	30	83
38	30	84
39	30	85
40	30	86
41	30	87
42	30	88
43	30	89
44	30	90
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52	30	98
53	30	99
54	30	100
55	30	101
56	30	102
57	30	103
58	30	104
59	30	105
60	30	106
61	30	107
62	30	108
63	30	109
64	30	110
65	30	111
66	30	112
67	30	113
68	30	114
69	30	115
70	30	116
71	30	117
72	30	118
73	30	119
74	30	120

[illegible]

FLAHERTY, GIOVARE ASSOCIATES, P C

PEAK  
4030  
171

CFS  
CMS  
INCHES  
MM  
AC FT  
THOUS CU M

6-HOUR  
4679  
1133  
1152  
292.49  
2320  
2862

24-HOUR  
1835  
52  
18.06  
458.75  
3639  
4489

72-HOUR  
802  
23  
19.73  
501.09  
3975  
4903

TOTAL  
96197  
2724  
19.73  
501.09  
3975  
4903

1\*GVF\*

STATION 1

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(\*)

1000	2000	3000	4000	5000	6000	7000	8000	9000	0
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00
10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00
12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00
13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00
14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00
15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00
17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00
18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00
19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00
20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00
22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00
23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00
24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00
25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00
27.00	27.00	27.00	27.00	27.00	27.00	27.00	27.00	27.00	27.00
28.00	28.00	28.00	28.00	28.00	28.00	28.00	28.00	28.00	28.00
29.00	29.00	29.00	29.00	29.00	29.00	29.00	29.00	29.00	29.00
30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00
31.00	31.00	31.00	31.00	31.00	31.00	31.00	31.00	31.00	31.00
32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00
33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00
34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00
35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00
36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00
37.00	37.00	37.00	37.00	37.00	37.00	37.00	37.00	37.00	37.00
38.00	38.00	38.00	38.00	38.00	38.00	38.00	38.00	38.00	38.00
39.00	39.00	39.00	39.00	39.00	39.00	39.00	39.00	39.00	39.00
40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00
41.00	41.00	41.00	41.00	41.00	41.00	41.00	41.00	41.00	41.00
42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00
43.00	43.00	43.00	43.00	43.00	43.00	43.00	43.00	43.00	43.00
44.00	44.00	44.00	44.00	44.00	44.00	44.00	44.00	44.00	44.00
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SUM OF 2 HYDROGRAPHS AT 7		1 PLAN 1		RTIO 8		TOTAL VOLUME	
6	7	8	9	10	11	12	13
12	12	14	15	10	11	12	13
123	24	28	39	17	20	21	22
170	285	335	398	45	50	51	52
226	147	123	106	377	323	324	325
174	112	124	134	91	72	73	74
85	112	124	134	149	154	155	156
199	274	320	367	444	473	474	475
232	845	1205	1328	2006	2217	2218	2219
657	6901	8573	9841	2543	2817	2818	2819
6528	1972	1672	1568	5161	4423	4424	4425
1308	607	583	537	1082	956	957	958
632	405	387	360	537	473	474	475
421	405	387	373	358	330	331	332
PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME			
6901	5348	2097	916	109940			
175	151	57	26	3113			
CM5	13	20	22	22			
INCHES	16	54	53	55			
MM	34	29	57	67			
AC-FT	28	47	43	49			
THOUS CU M	262	4157	5604	5604			
CU M	3271	5130	5604	5604			

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STATION	1
INFLOW (T.)	4000
OUTFLOW (Q)	5000
AND OBSERVED FLOW(★)	6000



FLANNERY GAVARA ASSOCIATES, P.C.

61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
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PEAK OUTFLOW IS 850. AT TIME 43.00 HOURS

PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME  
 850. 662 261 113 13563  
 24. 19 7 3 384  
 CFS 1.63 2.57 2.78  
 CMS 41.36 65.37 70.65  
 INCHES 328 519 560  
 MM AC-FT 403 640 691  
 THOUS CU M

1\*OVF\*

STATION 1

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(\*)

	100	200	300	400	500	600	700	800	900	0	0	0	0
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15 30113  
16 00114  
17 30115  
18 00116  
19 30117  
20 00118  
21 30119  
22 00120

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STATION 1, PLAN 1, RATIO 2  
END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW		STORAGE	
1	2	1	2
1	2	0	0
2	4	1	1
3	39	1	1
4	57	6	9
5	24	9	4
6	49	4	6
7	173	8	14
8	1718	16	48
9	1718	33	44
10	1718	33	44
11	1718	33	44
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99	1718	33	44
100	1718	33	44

[illegible]

FLAK OUTFLOW IS 1727 AT 111L 43 00 HOURS

	PLAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
CPS	1227	1527	154	227	27189	770.
CMS	49	38.	5	6		5.58
INCHES		3.27	5.15	5.38		141.63
FM		82.95	130.91	141.63		1124
CU-FT		1038	1281.	1386		1386.
THOUS		812				

1202

STATION 11

INFLOW(I),	OUTFLOW(O)	AND OBSERVED FLOW(*)
200	400	1000
	600	1200

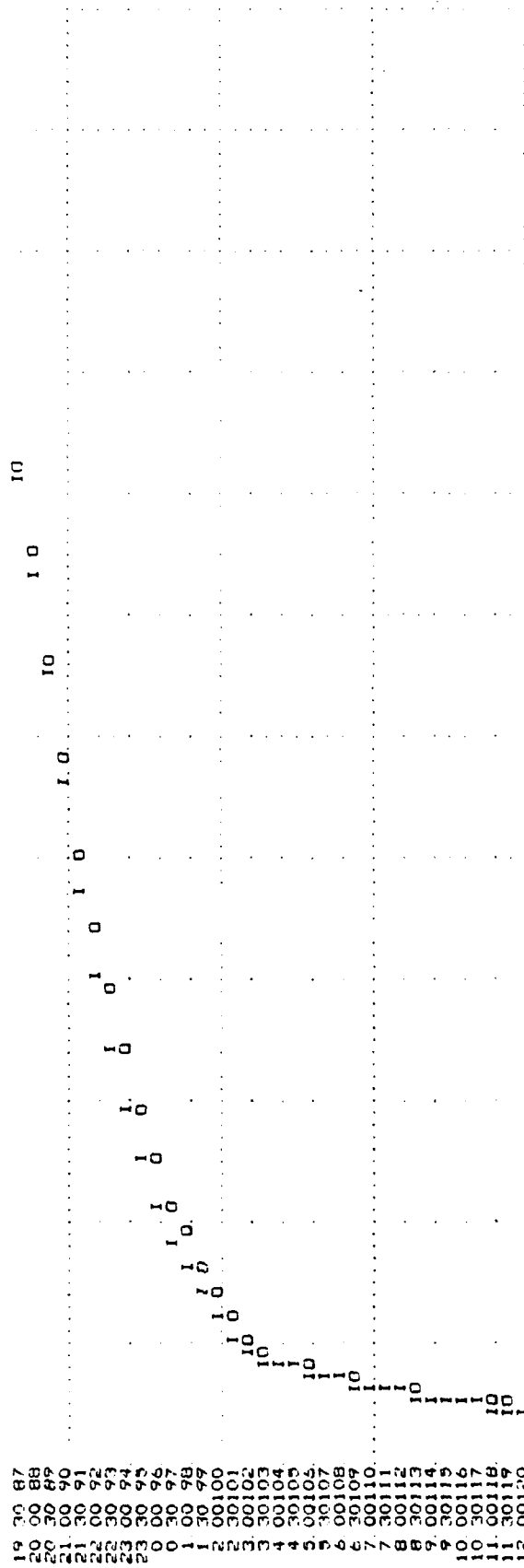
INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(F)

[illegible]

FLAHERTY GIAVARA ASSOCIATES, P C

14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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C-66

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STATION		1. PLAN 1, RATIO 3	
END-OF-PERIOD HYDROGRAPH ORDINATES			
	OUTFLOW		STORAGE
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
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7	7	7	7
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24	24	24	24
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119	119	119	119
120	120	120	120



PEAK OUTFLOW IS 2992. AT TIME 43.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
GFS	2592	2001	786	341		40885
CMS	73	57	10			1158
INCHES		4.92	7.74	8.38		8.38
MM		125.09	196.53	212.97		212.97
AC-FT		992	1559	1689		1689
THOUS CU M		1224	1923	2084		2084

1 → OV \*

STATION 1

INFLOW(I),	OUTFLOW(Q)	AND OBSERVED FLOW(*)
800.	1200	2000
	1600	2400.

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FLAHERTY GIAVARA ASSOCIATES, P C

8 30 171  
9 30 181  
10 30 201  
11 30 211  
12 30 221  
13 30 231  
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84 30 941  
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87 30 971  
88 30 981  
89 30 991  
90 30 1001  
91 30 1011  
92 30 1021  
93 30 1031  
94 30 1041  
95 30 1051  
96 30 1061  
97 30 1071  
98 30 1081  
99 30 1091  
100 30 1101

13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534</
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STATION 1, PLAN 1, RATIO 4  
END-OF-PERIOD HYDROGRAPH ORDINATES

[illegible]

[illegible]

PEAK OUTFLOW IS 3457 AT TIME 43 00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
CFS	3457	2673.	1048.	455.	54583.	
CMS	98	276.	30.	13.	1546.	
INCHES		16.58	10.32	11.19	11.19	
MM		167.05	262.05	284.32	284.32	
AC-FT		1325	1325	2356.	2356.	
THOUS		1635	2564.	2782.	2782.	

100yf

STATION 1

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)	2000	2400
1200	1600	

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0-1-10

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AC-FT  
THOUS CU M

2822  
3480

2822  
3480

2599  
3205

1656  
2043

1\*OVF\*

STATION 1

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(\*)

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9	30112	1
10	30113	10
11	30114	1
12	30115	1
13	30116	1
14	30117	1
15	30118	10
16	30119	1
17	30120	1

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STATION 1, PLAN 1, RATIO 6  
END-OF-PERIOD HYDROGRAPH ORDINATES

STATION	1	PLAN 1	RATIO 6	OUTFLOW	STORAGE	STAGE
1	1	1	1	1	1	1
2	2	2	2	2	2	2
3	3	3	3	3	3	3
4	4	4	4	4	4	4
5	5	5	5	5	5	5
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97	97	97	97	97	97	97
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 1248 2 1247 8 1247 6 1247 4 1247 3 1247 3 1247 2 1247 0  
 1246 9 1246 8 1246 8 1246 7 1246 6 1246 6 1246 5 1246 4

PEAK OUTFLOW IS 5184 AT TIME 43 00 HOURS

PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME  
 5184 4009 1572 683 81979  
 147 114 45 19 2321  
 CFS 15 48 16 81 16 81  
 INCHES 250.60 393.08 427.03  
 1988 3118 3388  
 AC-FT 2452 3845 4178  
 THOUS CU FT

180000

STATION 1  
 INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(\*)

	1000	2000	3000	4000	5000	6000	
0 11							0
0 30							0
1 00							0
1 30							0
2 00							0
2 30							0
3 00							0
3 30							0
4 00							0
4 30							0
5 00							0
5 30							0
6 00							0
6 30							0
7 00							0
7 30							0
8 00							0
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18 30							0
19 00							0
19 30							0

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FLAHERTY GIAVARA ASSOCIATES, P C

12 30 32 I  
13 30 33 IO  
14 30 34 I  
15 30 35 I  
16 30 36 I  
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STATION 1, PLAN 1, RATIO 7  
END-OF-PERIOD HYDROGRAPH ORDINATES

	1	2	3	4	5	6
1	1	7	17	3	13	14
2	16	83	19	11	32	39
3	247	215	193	32	319	305
4	143	211	155	111	187	178
5	432	157	181	114	123	129
6	2870	457	208	317	355	385
7	683	507	612	1711	2131	2730
8	418	5651	6013	3202	4595	3979
9		2073	1771	5202	992	889
10		617	554	1141	471	453
11		401	370	327	314	301
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PEAK OUTFLOW IS 6048 AT TIME 43 00 HOURS

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
6048	4677	1834	797	95678	2709
171	132	52	23	19 62	498 38
	11 51	18 05	498 38	3954	4877
	292 38	458 60	4877		
	2319	3638			
	2861	4487			

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3 30	3 30	3 30	3 30	3 30	3 30	3 30	3 30	3 30
4 30	4 30	4 30	4 30	4 30	4 30	4 30	4 30	4 30
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FLAHERTY GIAVARA ASSOCIATES, P C

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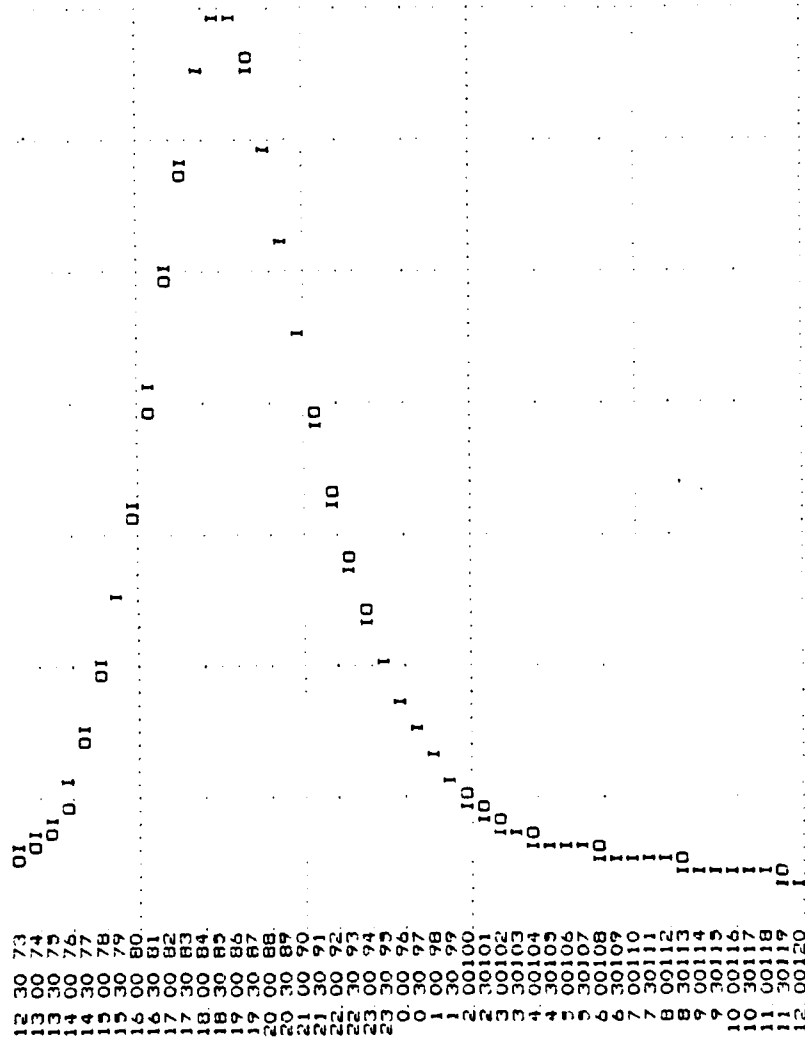
STATION 1, PLAN 1, RATIO B  
END-OF-PERIOD HYDROGRAPH ORDINATES

STATION	1	2	3	4	5	6
1	17	18	19	20	21	22
2	36	71	103	165	210	224
3	319	282	245	178	108	337
4	155	78	84	93	108	108
5	146	179	203	235	275	345
6	469	525	583	697	916	1910
7	3940	5743	6460	6873	6911	5942
8	3871	2777	2363	2022	1737	1297
9	873	700	662	633	606	559
10	494	458	440	423	406	374
11	15	16	17	18	19	20
12	45	46	47	48	49	50
13	349	350	351	352	353	354
14	86	87	88	89	90	91
15	148	149	150	151	152	153
16	440	441	442	443	444	445
17	3111	3112	3113	3114	3115	3116
18	4543	4544	4545	4546	4547	4548
19	974	975	976	977	978	979
20	513	514	515	516	517	518
21	345	346	347	348	349	350



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7	30	151	
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9	00	171	
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11	00	201	
12	00	211	
13	00	221	
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16	00	251	
17	00	261	
18	00	271	
19	00	281	
20	00	2901	
21	00	3001	
22	00	311	
23	00	321	
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27	00	361	
28	00	371	
29	00	381	
30	00	401	
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61	00	711	
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64	00	741	
65	00	751	
66	00	761	
67	00	771	
68	00	781	
69	00	791	
70	00	801	
71	00	811	
72	00	821	



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STATION 1, PLAN 1, RATIO 9  
END-OF-PERIOD HYDROGRAPH ORDINATES  
OUTFLOW

1	2	3	4	5	6	7	8
1	11	13	14	15	16	17	20
22	23	26	27	29	32	37	36
70	95	215	282	352	409	454	436
394	394	261	222	188	154	135	102
194	94	109	124	139	154	176	185
193	205	253	295	345	400	466	553
540	521	727	887	1302	1831	2507	3888
943	6086	8081	8998	8637	7420	6055	3871
811	4090	2954	2518	2167	1815	1594	1200
914	858	819	785	753	698	671	644
594	570	547	526	505	485	449	431

STORAGE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100

[illegible]

PEAK OUTFLOW IS 8537 AT TIME 43 00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
CFS	8537	6682	2650	1140	13673	3873
CMS	245	189	74	32		28.05
INCHES		25.79	65.14	28.05		712.45
MM		17.69	55.14	21.63		5652
AC-FT		3314	5197	5652		6971
THOUS CU M		4087	6411	6971		

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STATION 1	
INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)	
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FLAHERTY GIVARA ASSOCIATES, P C

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FLAVENTY CIAVARA ASSOCIATES, P C

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PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS  
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)  
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1 0.10	RATIO 2 0.20	RATIO 3 0.30	RATIO 4 0.40	RATIO 5 0.50	RATIO 6 0.60	RATIO 7 0.70	RATIO 8 0.80	RATIO 9 1.00
HYDROGRAPH AT	1	2.09 (5.41)	1	467	935	1402	1870	2337	2804	3272	3739	4674
				(13.24)	(26.47)	(39.71)	(52.94)	(66.18)	(79.41)	(92.65)	(105.88)	(132.36)
HYDROGRAPH AT	1	1.69 (4.38)	1	399	798	1196	1593	1994	2393	2791	3190	3908
				(11.29)	(22.58)	(33.88)	(45.17)	(56.46)	(67.75)	(79.04)	(90.33)	(112.92)
2 COMBINED	1	3.78 (9.79)	1	863	1725	2588	3450	4313	5176	6038	6901	8626
				(24.43)	(48.85)	(73.28)	(97.70)	(122.13)	(146.56)	(170.98)	(195.41)	(244.26)
ROUTED TO	1	3.78 (9.79)	1	850	1727	2592	3457	4320	5184	6048	6911	8637
				(24.07)	(48.90)	(73.38)	(97.90)	(122.34)	(146.78)	(171.26)	(195.70)	(244.56)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1	RATIO OF PMF	ELEVATION STORAGE	MAXIMUM RESERVOIR W.S. ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1	0.10	1248.73	1248.73	0.00	43	850	0.00	43.00	0.00
	0.20	1249.70	1249.70	0.70	53	1727	5.00	43.00	0.00
	0.30	1250.20	1250.20	1.20	59	2592	7.00	43.00	0.00
	0.40	1250.64	1250.64	1.64	64	3457	8.50	43.00	0.00
	0.50	1251.05	1251.05	2.05	69	4320	10.00	43.00	0.00
	0.60	1251.43	1251.43	2.43	73	5184	11.50	43.00	0.00
	0.70	1251.78	1251.78	2.78	78	6048	12.00	43.00	0.00
	0.80	1252.11	1252.11	3.11	82	6911	13.00	43.00	0.00
	1.00	1252.72	1252.72	3.72	90	8637	13.00	43.00	0.00
	1.00	1252.72	1252.72	3.72	90	8637	13.00	43.00	0.00

1\*\*\*\*\*  
FLOOD HYDROGRAPH PACKAGE (HEC-1)  
DAM SAFETY VERSION JULY 1978

PAGE 0072

FLAIRIN GIAVARA ASSOCIATES, P C

LAST MODIFICATION 26 FEB 79  
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APPENDIX D

PREVIOUS INSPECTION REPORTS/AVAILABLE DOCUMENTS

EXCERPTS FROM TECHNICAL SPECIFICATIONS



# THE NORWICH WATER WORKS.

## CONTRACT.

THIS AGREEMENT, made the Fourth day of April  
1890: Between The Norwich Water Works, of Norwich, New York, party of the first part, and  
City Public Works Company - Limited

.....party of the second part :  
WITNESSETH, That said party of the second part has agreed, and by these presents do agree to and with said parties of the first part, for the consideration hereinafter mentioned, and of the covenants and agreements herein mutually entered into, and under the penalty expressed in a certain bond bearing even date with these presents: to perform, furnish and provide, and deliver to the parties of the first part, at its own proper cost and expense, all the labor and materials of whatever kind, and to execute and perform in the most workmanlike manner, of the best materials, and in the manner, and subject to all the requirements of the Specifications, all the work mentioned, enumerated and called for in the following Specifications, which Specifications are hereby made a part of this agreement and contract :

## SPECIFICATIONS.

Description. The work will consist of the construction of a Storage Reservoir in the town of Norwich, N. Y., and situate above what is now termed "the Storage Reservoir" of the Norwich Water Works aforesaid, and all other work necessary to meet the demands and intent of the plans designed therefor, subject to such modifications as the Engineer may make by reason of unforeseen causes or otherwise.

Foundations of all embankments. All embankments are to be constructed upon a well prepared and solid foundation; and the payment rendered will be deduced from the schedule of prices expressed in the proposal for the various materials excavated, or otherwise constructed therefore, regardless of depth or expanse in any direction. In final, the Contractor should exercise his own judgment, arrange his prices and cover all contingencies by the price designated in the proposal for excavation.

Material for embankments. The material with which all embankments are to be made, will be such as is best suitable for the purpose intended, and excavated from such points as the Engineer may direct, and in case any or all such material be found to exist within the consequent slopes.

The Material paid for.

Guarantee.

necessary to effect the final flow line of the said Storage Reservoir and for By-Pass Canal shall be paid for in excavation and as otherwise provided, but in case of any excavation being made *outside* of the same, embracing rock and necessary stripping therefore, shall not be paid for in excavation, *excepting material for puddle*, hence the only payment to be awarded to the Contractor in such case, will be that deduced from his or their schedule of prices for the work constructed *in place* with *such borrowed material*. The Norwich Water Works does not guarantee the existence of all necessary material within the limits of the boundaries of its lands.

Formation of the embankment.

Disposition of material in the embankment.

Frozen material.

Dressing of borrow-pits.

Final measurements, etc.

Spoil banks.

Measurement for earthwork.

Supply, how controlled.

All material used for the purpose aforesaid shall be deposited properly in courses extending longitudinally with the bank, having a concaved surface transversely so as to retain a depressed surface at point of puddle wall as represented by the plan, and the various courses so applied, must be of approved material, entirely free from all such stone, lumps, roots and foreign matter as will be deemed detrimental by the Engineer, and the said courses must not exceed a thickness of eight inches at the time of deposit, after which, if considered necessary by the Engineer, it must be rolled with a grooved iron roller weighing at least six hundred pounds to the lineal foot, to such extent as to compact the said course to a degree of hardness approved by said Engineer, and should the action of said roller fail to transmit sufficient hardness, or result in rendering an imperfect bond, the material thus rolled must be sprinkled or wetted sufficiently with water, and if necessary, be re-rolled until sufficient compactness is finally attained. The finest and most appropriate material hauled from time to time upon the bank, must be deposited upon the entire width of the front slope, and be extended also upon the rear slope for at least a distance of ten feet from the rear face of the puddle wall. The construction of rear slopes must receive the same care and attention as specified for the front slope. In final, the only difference allowed between the front and rear slopes is that the material built into the outer portion of said rear slope may be coarser and may also contain a greater percentage of stone, but the amount of stone thus placed will be discretionary with said Engineer during the time of construction. Frozen material will be disallowed in every instance, and the amount and payment allowed the contractor for said frozen material will be discretionary with the Engineer.

The face of each and every excavation and borrow-pit must be dressed down and trimmed off so as to produce a good tidy appearance at date of completion, which expense must be covered by the price for earth excavation for material placed in embankment. The final measurements taken by the Engineer of all material having been used, made and placed into the work, will occur upon such dates as he may decide upon, but in no case shall he postpone it unnecessarily, neither shall the Contractor impede the transaction in any form or manner; but on the contrary furnish all facilities, and at times, assistance in obtaining measurements, data, etc. The Reservoir embankment will, so far as possible, be built in conformity with the sections represented by the plans.

If necessary, a part, or all of the natural soil, consisting of muck, etc., occupying the area covered by the flow line and embankments, will be hauled into spoil-banks, for subsequent use on the rear slope of said embankments.

N. B.—All earthwork will be measured for payment in excavation only, except, that extra payment will be made for puddle, as herein provided.

Earth moved more than once is not to be measured a second time, excepting puddling material and muck as herein specified. Preparation of surfaces for complete incorporation of additional material are not to be measured until after having attained a depth of eighteen inches, after which the contract price will be paid.

The supply for the Distribution System, or to the "Distributing Reservoir," will be controlled by valves placed within a masonry Inlet Chamber, provided with a bridge as per plans, thence passing through a twenty-four or twenty-inch cast-iron pipe, as may be decided upon, extending under the embankment; said pipe being thoroughly supported throughout its entire length, and if deemed necessary, a cement masonry wall, or cut-off wall, will be built at its junction with the puddle trench, or as otherwise directed.

**Location of Stop walls.** The Engineer will designate certain points at which stop-walls, consisting of either cement masonry, concrete, puddle or select material, will be built in under and all around said pipe, in accordance with directions, and number required, and the material so placed, must be executed by *experienced workmen*. The foundation of the puddle trench will be extended down and into a solid and impervious material, and the width at bottom shall be not less than that deemed necessary by the Engineer at the time of construction, which perhaps in no case, will be less than five feet, from which point it will ascend with a variable width, filling every void, situate between said foundation and the original line of the natural surface of the ground, at which point it must be lined into position, also to the proper width, and receive henceforth a batter of about one inch per foot, upon either side of the wall, and terminate with a top width of five feet, at a point situate two feet above the flow line.

**Rip-rap.** The slope-lining, or rip rap, will consist of stone either wasted from the excavation pit, or procured otherwise, and the price named in the proposal, is for hauling and placing said material only. Payment for excavation will occur only where the stone is taken from excavation pits.

**Surface puddling.** If deemed necessary by the Engineer, puddle will be placed upon the surface of Reservoir bottom; also into crevices, fissures, etc., and in fact every part of the work; but before so doing, all stone, roots, and perishable matter must be thoroughly removed, from the point of application.

**Right of changing plans and amount of work.** The amount of work, and the plans therefor may be changed, during the progress of construction, if so ordered by the Engineer; but the contract price shall remain the same, for all *material named* in the schedule of prices.

**Approximate quantities.** The approximate quantities of the work to be done, and as stated in the Quantity Sheet are *approximate only*; and the Corporation reserve the right to increase or diminish them as they may deem necessary.

**Price bid to include all work and material.** The price bid for each item, is to include the cost of all work and materials incidental thereto, such as bailing, pumping, and draining away water, furnishing all necessary tools, furnishing centers for masonry, furnishing water for all uses, etc., etc. It is intended that this specification shall provide for the full completion of the work above mentioned, ready for use, except as herein specially mentioned; and all labor and materials necessary to that end are to be *included in the items to which prices are attached*.

**Crude timber becomes property of Contractor.** All the wood and timber directed to be cut, and herein considered under the head of grubbing and clearing, becomes the property of the Contractor, who must haul it immediately from off the grounds, and deposit all debris of whatever class at points approved by the Engineer.

**Skilled labor.** The construction work must be done by competent men, skilled in the capacities assigned them by the Contractor.

**Excavation classed.** All excavation is to come under the head of earth or rock; the latter to include all hard rock found in a mass of one cubic yard or more, for which explosives, in the opinion of the Engineer must necessarily be used.

All other material found in excavating, of whatever nature, including disintegrated rock, or any other material that can be removed with picks or bars, shall with the exception of muck, come under the head of earth.

The price for earth and rock excavations shall apply to all trenching and foundations for masonry, puddle, concrete, etc., and permanent earth-work of any description necessary for the construction of the works connected herewith.

**Muck.** In case a deposit of muck is found, the Engineer may require its removal to such place as he may indicate. The payment for the same being at the price in proposal per cubic yard.

#### NEW PICKET FENCING.

**Fencing.** A picket fence composed of good seasoned hemlock, free from all detrimental qualities, will, if required, be constructed in conformity with the plan, and upon such lines, directions, etc., as the Engineer may direct. The posts shall be of good, sound chestnut, entirely free from its bark, and have a diameter of at least six inches, midway of tip and butt, and

a length of not less than nine feet, all of which shall be set plumb, at intervals of six feet between centers. The back-filling shall be selected from the excavation made for the post-hole, and should such material fail to provide a sufficient amount to refill around said post, in a permanent and satisfactory manner, it must be taken from the general surface of the ground, and completed in a manner as not to produce a trench or pit-hole. The back-fill must be free of stone and thoroughly rammed with properly constructed rammers, during the operation of refilling.

Dimensions.

The pickets shall be four inches wide at base, three inches wide at top, one and one-quarter inches thick, and six and one-half feet long, spaced at intervals of seven inches apart at centers. They are to be securely nailed to a top, center and bottom rail, being two by four inches wide; and also finished off by a rail at top and bottom, planted upon the pickets in the manner represented by said plan, and the whole to be executed in a good and workmanlike manner. In case it is necessary to grade up or off such material as the engineer may direct in order to maintain a reasonably parallel grade between the base of the pickets and the finished surface of ground line, the same must be done, and the cost thereof must be included in price per linear foot of fence complete.

Gates.

N. B.—At points designated by said Engineer, substantial swing-gates shall be constructed of the aforesaid material.

The necessary hinges, locks, hasps and cross-bars, shall be of approved class and material. The entire set of locks must be of the same pattern; accompanied with duplicate keys, and the cost of said gates per linear foot must be covered by price per linear foot specified in the schedule sheet of prices.

#### TIMBER BRIDGE.

Material.

At the point designated by the Engineer, a timber farm bridge of the form, span, etc., represented by the plans may be built across the By-Pass Canal, and the material called for and built into said structure, must be of first-class, well seasoned Georgia pine lumber painted in two coats of good mineral paint.

And the material constituting the tie or suspension rods must be of good, pure, soft Swedish iron, upset at ends, upon which threads of the form shown upon the plan will be properly cut.

A Guard Rail, of the form also represented, will be built across both sides of the bridge, and be securely fastened to the string-piece as represented on said plan.

The price for the various classes of material in place, must cover the cost, etc., of every item.

Wrought iron bridge in lieu of timber bridge.

In case it be deemed advisable by the Corporation aforesaid, a wrought iron bridge, represented by "Plan A," will be adopted instead of the timber bridge above mentioned. It shall be fourteen feet wide, and be planked with such material as the Engineer may select from the quantity sheet. All the iron and such parts of the wood work as may be deemed necessary, must be painted in two coats of the best mineral paint.

#### IRON FOOT BRIDGE.

Iron foot bridge in lieu of timber foot bridge.

In case the said Corporation decide to adopt the wrought iron foot bridge, represented on plan "A", the same shall be constructed in accordance with said plan, and be painted in two coats of good mineral paint, and payment therefor, all in place exclusive of flooring, will be made per lineal foot, and should circumstances necessitate an increase or diminution in its length by reason of shifting the proposed location of the Inlet Chamber, the said additive or deductive amount will be covered and adjusted by the schedule price per lineal foot.

Adjustment of increase or diminution.

Items compared separately.

In canvassing the bids, the price, etc., of the Iron Farm Bridge, Iron Foot Bridge and Gate House upon Inlet Chamber (of corrugated iron siding) will be compared separately.

#### INFLUENT CHAMBER.

The Influent Chamber situate at influent end of the mud pipe proper, may be of the logs cut from the trees obtained from off the site of the work, provided such be accept-

Frame work of  
crude  
material.

able. It will be of the dimensions represented upon the plans, and the framing will consist in halving the ends to a reasonably fitting joint and be pinned alternately, log upon log, as represented, with wooden pins of hard wood, having a diameter of not less than one and one-half inches.

The grating will consist of three-quarter inch wrought pipe secured by staples, and the structure back filled with good sized stone of approved form.

The timbers forming the structure must be sound and entirely free from bark, and completed for a lump sum.

Frame work of  
squared tim-  
ber

In case squared timber be used, packing blocks must be inserted between said timbers so as to leave a void sufficient for the percolation of water to the mud pipe. In such case the work will be paid for as per schedule price for such material. The Engineer will decide as to which will be used at time of construction.

### MASONRY.

#### INLET CHAMBER.

The masonry of the Inlet Chamber must be of a quality that will insure durability and also be impervious to water, the object being to afford the opportunity of descending into the same without drawing off at any time the stored waters of the Reservoir, and will be built according to the plan so far as is practicable, but if in the opinion of the Engineer circumstances necessitate a shift or change from the position represented upon the map, the change so made shall not increase or decrease the prices given in the proposal. The work must be executed by masons skilled in this particular class of work. Inexperienced workmen will not be allowed upon any portion of work falling under the head of Rubble Masonry.

#### SCREEN LUGS.

At a point situate about three feet below the central axis of the upper inlet, three iron plugs will be inserted into the fourteen-inch stand pipe sufficiently to project through the shell of said pipe in a manner as to afford a safe and substantial resting place for the basket screen, and the cost of the same must be included with that of setting the stand pipe.

#### VALVE RODS.

The Valve Rods must be securely fastened to the valves by a key, and be extended to the upper surface of the floor, supported throughout their length so as to maintain a plumb position and operate easily, as may be directed by the Engineer at time of construction. The heads of the said rods must have a bearing upon a cast iron collar planted and fastened to the flooring of the Inlet Chamber in such manner as not to extend above the general plane of the surface of said flooring, and the size of each valve operated, must be designated with red paint, also the direction for closing, by an arrow plainly scribed upon the floor, and directly opposite the rod for which it is intended.

### GATE HOUSE.

#### WOOD STRUCTURE.

Ceiling.

Floor.

The Inlet Chamber will be surmounted by a Gate House as represented on the plan. The material used, in case the structure be built entirely of timber, shall be of good seasoned pine, encased upon the outside with sheeting paper of best quality and by two-inch clear lumber, tongued and grooved, planed and wrought in conformity with plans, in a good workmanlike manner. The sides and ceiling on the interior will be sheeted with good sheeting paper and one-inch pine lumber, tongued and grooved, as aforesaid. The floor will consist of good, well-seasoned one-inch pine and one-inch spruce, cross-laid, with proper provisions for trap door, gate rods, etc.

#### WINDOWS AND DOORS.

All swing doors shall be provided with good substantial butt hinges, and where necessary good substantial latches and locks appropriate for the purpose and situation. The



The payment to be made for said Lamp Holes will be rendered per lineal foot, *vertical measurement*, from hub of T, with which the same is connected, and shall also include the cost of the frost-wall, material, labor, etc., with exception of the roofing, which shall be paid for per B. M.—as otherwise provided.

#### BY-PASS PIPE LINE.

The twelve-inch By-Pass Pipe Line will be commenced at a point situate in the line of twenty-inch mud pipe of the Storage Reservoir, as represented upon the map, from which point it will be extended in a westerly direction around the southerly side of the Distributing Reservoir and be connected with the Pipe Main of the Distribution System in such manner as to admit of a 10-inch Blow-off discharging into the original creek bed.

The weight of all straight cast pipe used upon said 12-inch By-Pass Line (in market lengths) must not deviate materially from the standard weights quoted by the Warren Iron Foundry, and generally known as "Class A" pipe.

#### BASKET GUTTER.

If deemed necessary a cobble stone basket gutter will be commenced and extended from and to all such points as the Engineer may designate at the time of construction.

The stone shall not be more than ten nor less than five inches in their longest dimensions and be of a material not liable to disintegrate nor crush. They shall be placed upon a ballast of creek gravel or coarse sand, having a depth of about twelve inches, prepared so as to make a depression of eight inches after the stone are rammed and paved into their final position.

The width of the gutter from out to out, shall be not less than four feet, and the stone used shall be graduated so as to increase in size from centre line toward either side.

The surface of the approach to, and into said basket gutter, must be so arranged as to prevent, as far as possible, any undermining effect caused by the water upon the outer courses of said gutter.

As the gutter approaches the Catch Basins, it must be so fashioned as to conduct the water properly into said basin, as represented upon the plans

#### ROCK.

In case any solid rock is found within the lines of excavation, it shall, if so ordered by the Engineer, be blasted out to such surfaces as he may direct, and any space so made beyond the grade surfaces of the work shall be properly filled with puddle, or otherwise treated as the Engineer may direct.

No payment will be made for excavations having been extended beyond the lines and limits previously designated by the Engineer.

#### PUDDLE

The material for puddle shall be the best the excavation affords, and freed from all stones more than an inch in diameter, and from perishable earth; and if in the opinion of the Engineer, different materials require mixing, they shall be intermixed in proper proportions while dry, after which a sufficient quantity of water shall be applied, and the whole well and thoroughly worked up and rammed or cross cut with proper tools operated by men experienced in this particular kind of work, until the layers become sufficiently tough to meet the approval of the Engineer, and be impervious to water.

Any surface to which the puddle is to be bonded is to be broken up and properly prepared for that purpose. If, in the opinion of the Engineer, it shall be needful to mix any clay or other material not found in the excavation, into the puddle, such material shall be furnished and delivered on the ground by the Contractor who shall incorporate it properly with the puddle, without extra charge.

The puddle shall be applied in horizontal layers, not exceeding six inches in thickness. Each six-inch layer shall be allowed to attain a proper consistency, but not dry, before another layer is applied; and if any portion of a layer shall have become hard and dry before the application of the following one, it shall be thoroughly broken up, watered and prepared, so as to insure a sufficient connection with the subsequent layer.

Puddle covered.

The finished surface shall be temporarily covered, when necessary, to prevent cracking from exposure to the sun or detrimental action of the frost.

Measurement of puddle.

All material falling under the head of puddle shall be measured in place, complete, and no allowances shall be made for *shrinkage*.

#### CEMENT.

Cement and its inspection.

All cement furnished by the Contractor for the entire work herein specified will be subject to inspection and rigorous tests, and, if found of improper quality, must be immediately removed from the work; and the character and severity of the tests are to be determined by the Engineer. It shall be of the best quality of American Hydraulic Cement, freshly ground, and must be packed in substantial barrels of material and workmanship as will protect the contents from water and air. When stored, it shall be kept in a tight building, free from draughts of air, and each cask must be raised several inches above the ground, by blocking or otherwise, so as to avoid the liability of absorbing moisture.

The particular brand to be used will depend upon the tests made by the Engineer with various specimens of cement mixed with the various sands found within the neighborhood of the works and the village of Norwich, and having decided upon which brand forms the best compound, the Contractor will be held to the same without any modification of schedule price or extras, and he or they shall use the same as directed.

#### MORTAR.

Mortar for stone masonry.

The mortar for the stone masonry shall be prepared by properly mixing one part of clear cement, well compacted, of the quality before described, and two parts of loose, sharp sand, *all by measure*.

Sand.

The sand shall be as clean, sharp and free from loam and frost as the section of country will admit. The cement shall be thoroughly mixed dry with sand, in the proportion of one part of cement to two parts of sand.

Water.

Clean water shall be added at such time, and in such quantity as to make a paste of the best quality and of proper consistence.

The whole shall be thoroughly worked with proper tools, in suitable boxes made for the purpose.

Mixed fresh.

The mortar shall be mixed fresh for the work in hand, and any mortar that may have been left standing long enough to "*begin to set*," shall not be used.

The ratio of sand and cement must be in accordance with experiment made by the Engineer, and should he consider a greater proportion of cement necessary the same shall be done without any extra charge.

#### CONCRETE.

Concrete.

The concrete shall be formed of sound and acceptable stone, either screened from gravel or broken so as to be not more than two and one-half inches in greatest dimension. The material shall be cleaned from frost, dirt and dust before being used, be properly wet, and thoroughly mixed with mortar in suitable boxes, in such proportions that the volume of mortar shall always be slightly in excess of the volume of voids in the broken stone.

2 1/2-inch stone.

Proportions.

The mortar used in concrete is to be such as above described for stone masonry, viz: one part cement to two of sand, or the proportions may be derived from test as aforesaid. The concrete is to be quickly placed in layers of about six inches in thickness, and thoroughly rammed with suitable rammers until the mortar flushes to the surface.

Rammed.

Not disturbed.

*No walking or working upon its surface will be allowed while the mass is setting, and sufficient time must elapse before any succeeding work is allowed to be laid upon it.*

All classes of work subject to injury from the action of frost, must be properly protected therefrom by the Contractor without extra charge.

#### RIP RAP.

After the bank is carried up sufficiently, the inner slope will be dressed true to a line given by the Engineer, and a layer of stone, averaging about fifteen inches in thickness, will be

Rip rap. applied. The stone used for this purpose must be sound, and shall be hand placed if required. Any additional depth of stone above that of fifteen inches will be allowed, provided the same be so placed as not to produce warped surfaces, but the additional depth so placed shall not constitute an extra price.

#### RUBBLE MASONRY.

Classification. The rubble masonry will be divided into two classes, viz: first and second, and the class adopted for the various structures will be designated by the Engineer at the time of construction, the probability being that the only structures built of the first class will be the Inlet Chamber and the Waste Weir, each of which may embrace both classifications.

Distinction between 2nd and 1st class. Both classifications will embrace *equally good stone*, the difference being that all face-work of the structures above mentioned, shall be stone assorted for the purpose, and in general receive a better degree of care and attention as regards fitness to perform the duty imposed upon them.

#### RUBBLE—FIRST CLASS

Jointage. The stone used will be of any formation that will not disintegrate, they shall have the property of being hammered or pitched, if necessary, to a line, and admit of being scabbled on bed and builos in order to obtain a satisfactory joint, the thickness of which will depend somewhat upon the size of the particular stone being set, which in no case shall be laid so as to admit of no mortar between it and the adjacent stones. In final, the joint must not be more than three quarters, nor less than one-quarter, of an inch.

Beds, etc. The stone must be perfectly clean and laid upon a properly prepared bed of mortar with its *best bed down*, and in no case shall spalls or any other medium be driven in for the purpose of leveling its upper bed. In the preparation of the bed, all chips and spalls used for the purpose must be carefully hand-laid and be hammered down until the mortar flushes to the surface, and when doing likewise with the larger stone, a wooden block must be employed. Regular courses are not to be called for, further than to approach it sufficiently to produce a good bond and a harmonizing effect, approved by the Engineer, more attention being paid to the said bond throughout the whole thickness of the walls than to regular courses.

Rods, ladders, etc. The insertion of anchor rods, ladders, etc., must be carefully set so as not to admit of any percolation of water. All dowels must be set in sulphur

Projections. All projections on the face side of the work exceeding two inches, must be scabbled off prior to setting the stone, and in no case shall any stone be set so as to form an inverted batter. After the work becomes sufficiently set for the purpose, the Contractor will clean out the joints of all such work as may be designated by the Engineer, and re-point the same with rich mortar, to the satisfaction of the Engineer.

How measured. Masonry of all classes are to be measured in the work only, excepting such as are otherwise provided for.

#### COPING.

The material for coping must consist of either good sound blue stone, or stone quarried at Oxford, N. Y. They will be "rock-faced," neatly pitched to parallel lines, and laid to a joint not to exceed three-eighths of an inch, and be bonded back into the masonry walls as represented upon the plans, and laid in good, rich cement mortar, mixed especially for the purpose. All imperfect stone, also stone having endured long exposure to the natural elements, etc., or discolored thereby, will be rejected.

The material called for in cases of spillways, bridge seats, etc., shall consist of equally good stone and workmanship.

How measured. All coping will be measured by the cubic yard in place as per quantity sheet, and no extra payment will be made for dimensions exceeding those upon the plan.

#### PAVEMENT IN CEMENT MORTAR.

Arrangement. The stone used for all slack-water basins will be of good substantial material, regardless of color, but practically similar in length. They are to be carefully arranged in place, upon a properly prepared bed, as per plans, and wedged, rammed, etc., until becoming positively fixed

PREVIOUS REPORTS

RECEIVED

MAY 6 1914

DIVISION OF INLAND WATERS  
NOTICE: One of these forms as completely as possible for each dam in your district, return it at once to the  
Chief Engineer  
(Conservation Commission, Albany.)

STATE OF NEW YORK  
CONSERVATION COMMISSION  
ALBANY

RECEIVED

MAY 8 1914

DIVISION INLAND WATERS

J. D. M.

DAM REPORT

No. 2

April 9, 1914  
(Date)

CONSERVATION COMMISSION,

DIVISION OF INLAND WATERS.

GENTLEMEN:

I have the honor to make the following report in relation to the structure known  
as the The Norwich Water Works Dam. No. 2.

This dam is situated upon the Ramford Brook  
(Give name of stream)  
in the Town of Norwich, Chenango County,  
about 9000 feet from the Village or City of Norwich.  
(State distance)

The distance down stream from the dam, to the Chenango River,  
(Up or down) (Give name of nearest important stream or of a bridge)  
is about 9000 feet.  
(State distance)

The dam is now owned by The Norwich Water Works  
(Give name of owner)  
and was built in or about the year 1891, and was has been extensively repaired or reconstructed  
and is in good order.  
during the year                     .

As it now stands, the spillway portion of this dam is built of masonry  
(State whether of masonry, concrete or timber)  
and the other portions are built of earth with clay core.  
(State whether of masonry, concrete, earth or timber with or without rock fill)

As nearly as I can learn, the character of the foundation bed under the spillway portion  
of the dam is rock and under the remaining portions such  
foundation bed is rock a-b, earth b-c

The total length of this dam is 638 feet. The spillway or waste-weir portion, is about 45 feet long, and the crest of the spillway is about 5' - 4" feet below the top of the dam.

The number, size and location of discharge pipes, waste pipes or gates which may be used for drawing off the water from behind the dam, are as follows: 36" main pipe with one 20" and 3 - 14" inlets

State briefly, in the space below, whether, in your judgment, this dam is in good condition, or bad condition, describing particularly any leaks or cracks which you may have observed.)

Reported by

(Signature)

173 Broad

(Address—Street and number, P. O. Box or R. F. D. route)

Norwich N.Y.

(Name of place)

(SEE OTHER SIDE)

(In the space below, make one sketch showing the form and dimensions of a cross section through the spillway or waste-weir of this dam, and a second sketch showing the same information for a cross section through the other portion of the dam. Show particularly the greatest height of the dam above the stream bed, its thickness at the top, and thickness at the bottom, as nearly as you can learn.)

See Plan

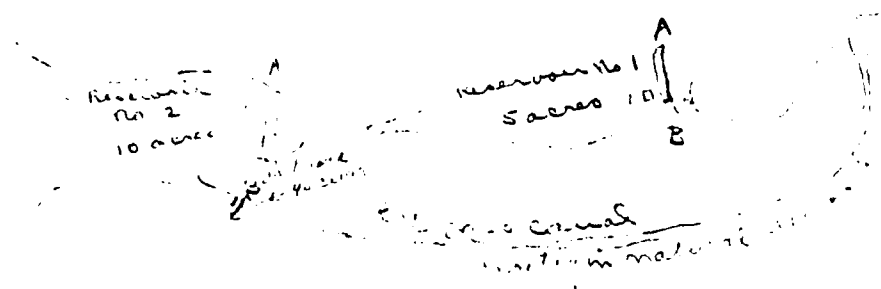
Parad

Arch

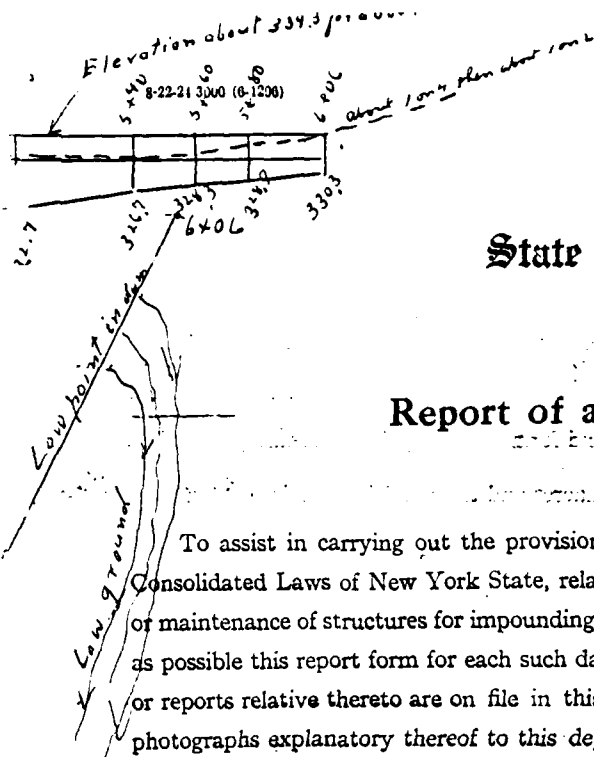
Arch

See Plan

(In the space below, make a third sketch showing the general plan of the dam, and its approximate position in relation to buildings or other conspicuous objects in the vicinity.)



A A spillways  
B B spillways



STATE OF NEW YORK

DEPARTMENT OF

State Engineer and Surveyor

ALBANY

Reservoir No 2

## Report of a Structure Impounding Water

To assist in carrying out the provisions of Section 22 of the Conservation Law, being Chapter LXV of the Consolidated Laws of New York State, relating to safeguarding life and property and the erection, reconstruction, or maintenance of structures for impounding water, owners of such structures are requested to fill out as completely as possible this report form for each such dam or reservoir owned within the State of New York for which no plans or reports relative thereto are on file in this Department, and to return this report form, together with prints or photographs explanatory thereof to this department.

1. The structure is on Rensselaer Creek flowing into Chenango River in the Town of Norwich County of Chenango and About 8000 feet from the mouth of the stream on the City Line.  
(Give exact distance and direction from a well-known bridge, dam, village main cross-roads or mouth of a stream.)

2. Is any part of the structure built upon or does its pond flood any State lands? No

3. The name and address of the owner is The Norwich Water Works  
Norwich N.Y.

4. The structure is used for Impounding Water Supply used in the City of Norwich

5. The material of the right bank, in the direction with the current, is Rock with earth above the spillway crest; at the spillway crest elevation this material has a top slope of about 6 inches vertical to a foot horizontal on the center line of the structure, a vertical thickness at this elevation of about 14 feet, and the top surface extends for a vertical height of about 16 feet above the spillway crest.

6. The material of the left bank is Hard pan; has a top slope of about 3 inches to a foot horizontal, a thickness of for a short distance then much steeper, and a height of about 400 feet.

7. The natural material of the bed on which the structure rests is (clay, sand, gravel, boulders, granite, shale, slate, limestone, etc.) Shale rock

8. State the character of the bed and the banks in respect to the hardness, perviousness, water bearing, effect of exposure to air and to water, uniformity, etc. The Rock on the right bank is somewhat laminated, in the bottom dense. The hard pan dense and impervious.

Rock disintegrates to some extent by exposure to the air. There has been no leakage from the reservoir during the 35 years since constructed



9. If the bed is in layers, are the layers horizontal or inclined? horizontal If inclined what is the direction of the horizontal outcropping relative to the axis of the main structure and the inclination and direction of the layers in a plane perpendicular to the horizontal outcropping?

10. What is the thickness of the layers? variable

11. Are there any porous seams or fissures? Some on the right bank but all cut off by concrete and clay puddle

12. The watershed at the above structure and draining into the pond formed thereby is about 5 square miles.

13. The pond area at the spillway crest elevation is about 8 acres and the pond impounds about 8 million cubic feet of water.

14. The maximum known flow of the stream at the structure was see note on page 3 cubic feet per second on May and Sept. 1890  
(Date)

15. Has the spillway capacity ever been exceeded by a high flow? No

Can any possible flood flow from the pond otherwise than through the wastes noted under 17 and 18 of this report? Yes If so, give the location, the length and the elevation relative to the spillway crest and the character and slopes of the ground of such possible wastes (see plan on page 4) For about 100 feet the bank, or dam, is from 6 inches to 1 foot lower than the crest of the main dam and on overflow there would follow a natural grassed bank, entirely away from the structure and discharging into Reservoir No. 1. See sketch on separate sheet attached

16. State if any damage to life or to any buildings, roads or other property could be caused by any possible failure of the above structure. Describe the location, the character and the use of buildings below the structure which might be damaged by any failure of the structure; of roads adjacent to or crossing the stream below the structure, giving the lowest elevation of the roadway above the stream bed and giving the shape, the height and the width of stream openings; and of any embankments or steep slopes that any flood could pass over. Also indicate the character and use made of the ground below the structure. There are 5 houses and a small school house in a rather narrow valley, also 3 other houses and farm buildings as the valley opens to the river valley. Also 2 stone arch bridges (see sketch) and a steel bridge on the river road and a highway in the river valley near the brook. The land is used for grazing and cultivation

17. WASTES. The spillway of the above structure is 43 feet long in the clear; the waters are held at the right end by a masonry wall the top of which is 6 feet above the spillway crest, and has a top width of 2.5 feet; and at the left end by the same, the top of which is 6 feet above the spillway crest, and has a top width of 2.5 feet.

18. There is also for flood discharge a pipe 36 inches inside diameter and the bottom is 4.0 feet below the spillway crest; and a (sluice, gate outlet) 3 feet wide in the clear by diameter feet high, and the bottom is 4.0 feet below the spillway crest.

19. APRON. Below the spillway there is an ~~apron~~ Rock bottom channel with side  
~~4.5 feet wide and unknown feet thick~~ (All around)  
~~The down stream side of the apron has a thickness of~~  
 for a width of 4.5 feet.

20. Has the structure any weaknesses which are liable to cause its failure in high flows? No

21. SKETCHES. On the back of this report make a sketch to scale for each different cross-section of the above structure at the greatest depth; giving the height and the depth from the surface of the foundation, the bottom width, the top width (for a concrete or masonry spillway at two feet below the crest), the elevation of the top in reference to the spillway crest, the length of the section, and the material of which the section is constructed; on the spillway section show a cross section of the apron, giving its width, thickness and material, and show the abutment or wash wall at the end of the spillway, giving its heights and thickness. Mark each section with a capital letter. Also sketch a plan; show the above sections by their top lines, giving the mark and the length of each; the openings by their horizontal dimensions; the abutments by their top width and top lengths from the upstream face of the spillway section; and outline the apron. Also sketch an elevation of each end of the structure with a cross section of the banks, giving the depth and width excavated into the banks.

22. WATER SUPPLY. The waters impounded by the above structure have ~~not~~ been used for a public water supply since 1891 by The City of Norwich (Formerly Village)

*Note!* During the construction of this work and before the completion of the rock cut in the bottom of the puddle bank, I think in the early part of May, 1890 a very heavy rainfall caused a flood that passing over the spillway of Reservoir No. 1 which is 45 feet long and 5 feet deep, was 3 feet deep.

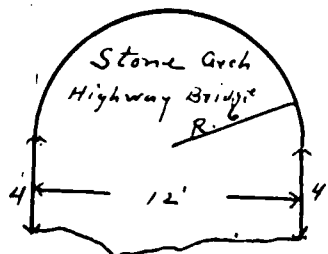
Again about Sept. 1 of the same year, when the work was 15 feet high a very heavy rain storm filled the pond to the top, but did not over flow but very little if at all. This storm all passed through about 200 feet of 36 inch pipe and filled the lower spillway to about the same depth as the earlier storm. The level of water 50 feet upstream was 3 feet above the top of the spillway.

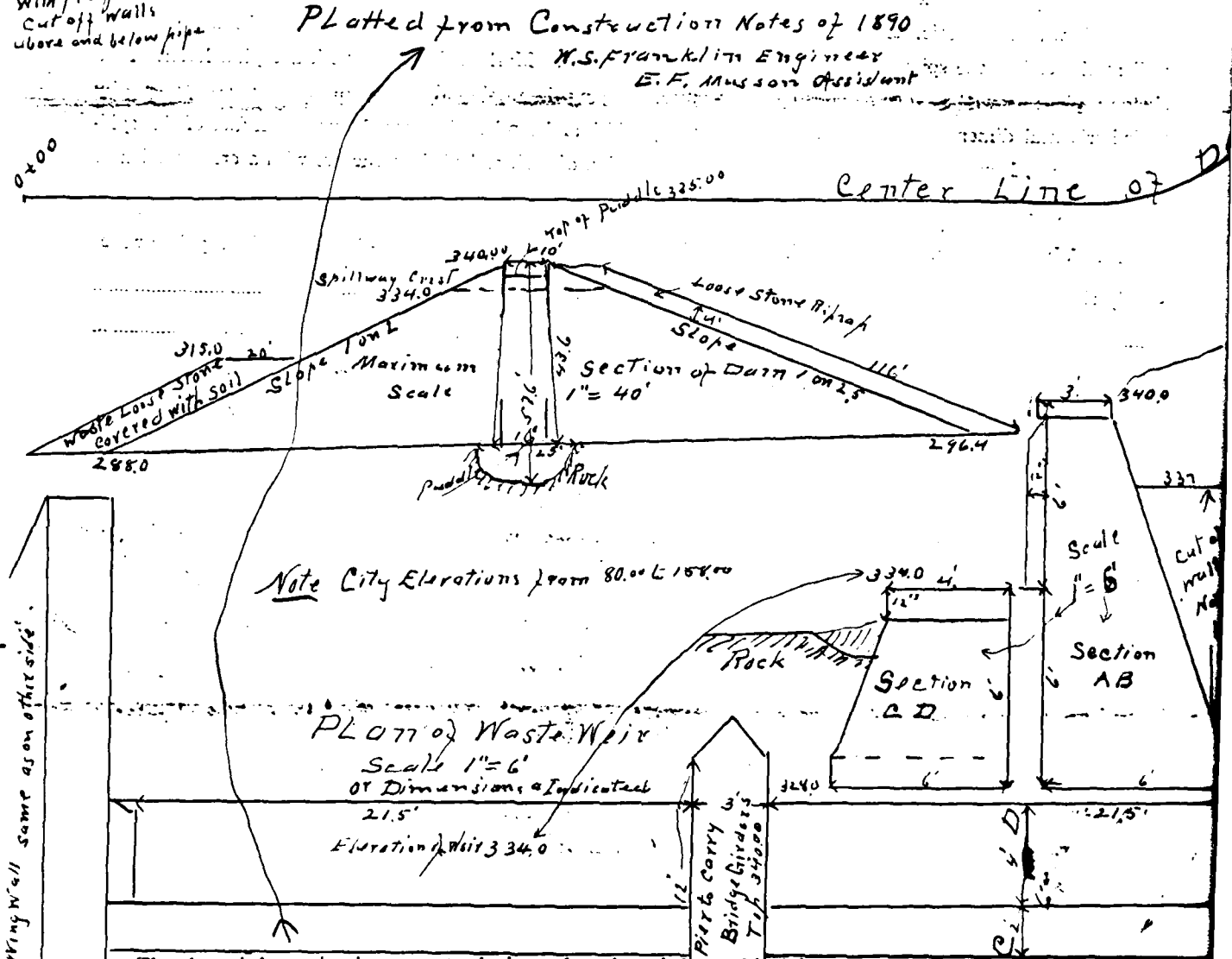
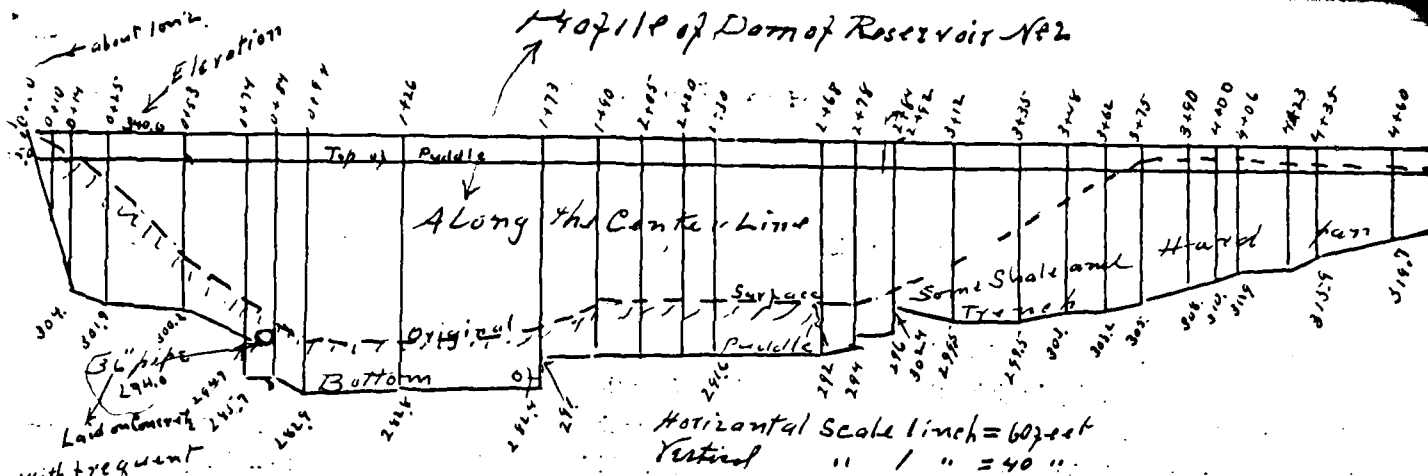
These discharges have never been equalled during the 35 years, to the knowledge of the writer, who was Assistant Engineer at the time of construction for the preceding 10 years before and since the construction of Reservoir No. 1.

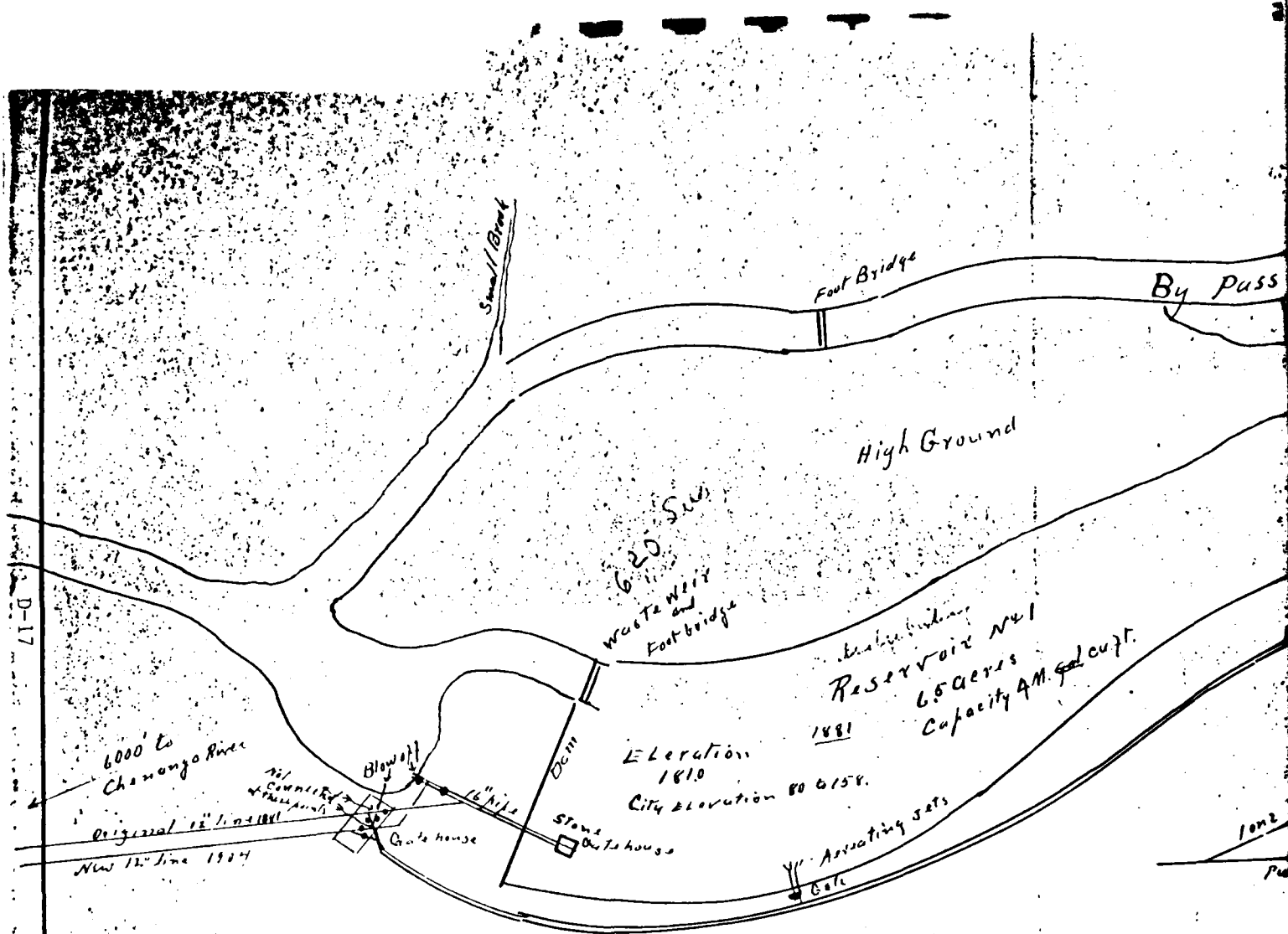
E. F. Musson.

I have received from the U.S. Weather bureau data concerning the precipitation at Oxford, 8 miles south for May and Sept. of 1890 as follows

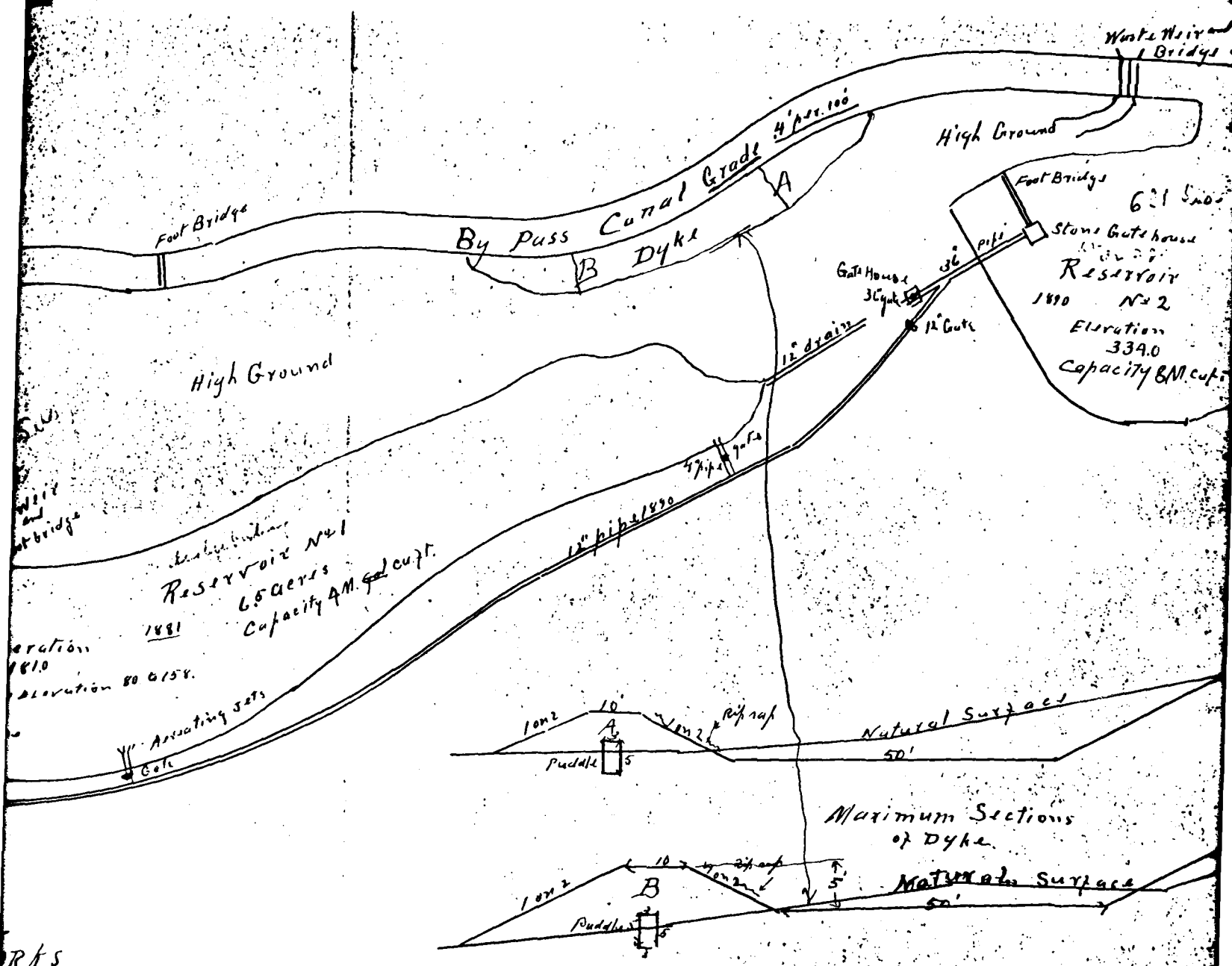
May	May 10-86	Sept. 9-10
46.68	11-10	10 30.4
5-57	13-12.0	11 8.1
6-11.2	14-1.7	12 3.9
		13 1.36







Sketch Map of the  
Reservoirs  
of  
The Norwich Water Works.  
Scale 1 inch = 200 feet.



Foot Bridge

By Pass Canal Grade  
Dyke

High Ground

Reservoir No. 1  
65 acres  
Capacity 4M. gal. cu ft.  
1881

Elevation 80 to 158.

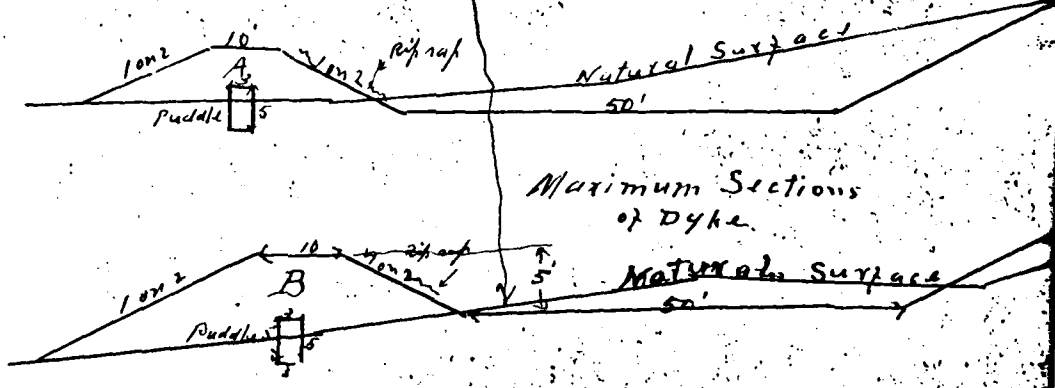
12 inch pipe  
Gate

Gate House  
30 ft. x 12 ft.

High Ground

Foot Bridge

Stone Gate house  
Reservoir  
No. 2  
Elevation  
339.0  
Capacity 8M. cu ft.



Maximum Sections  
of Dyke

Natural Surface

RHS

M. AM. SOC. C. E.  
(RESIGNED)

E. J. RUSSON

Civil Engineer

OFFICE AND RESIDENCE 10 SHELTON ST.

RECEIVED  
OFFICE STATE ENGINEER

APR 20 1925

REF'D TO *Section*  
ANS'D

NORWICH, N. Y., April 16, 1925.

Department of State Engineer and Surveyor,  
Albany, N. Y.  
Gentlemen;-

As requested by your department, I enclose herewith reports concerning the two earth dams and appurtenances owned by The Norwich Water Works of this City.

That designated as Reservoir No. 1, was constructed in the year 1881. The information in regard to that has been mainly obtained from preliminary plans prepared before the construction, together with some measurements of parts that are now accessible and readily measured.

Since the construction of Reservoir No. 2, it has been in use as a distributing reservoir, the overflow ~~overflow~~ from reservoir No. 2 passing in a by-pass canal.

The supply from reservoir is discharged into reservoir No. 1 through aerating jets. In times of heavy rains when the water in No. 2 is roily this is shut off till the water is in good condition for use.

The elevations used in the construction of both reservoirs are derived from an arbitrary bench mark near the center of the City, the elevation of which is assumed as ~~100.814~~ 100.814 and is located on the top of the water table at the North East corner of the Congregational Church.

Reservoir No. 2 was constructed in the year 1890. The Hon Richard W. Sherman was engaged with Mr. McDonough in the Troy Public Works Co. as contractors. Mr W.S. Franklin was Engineer in charge, with the writer as assistant. The information contained in the report concerning this reservoir is from the original construction notes and drawings used in the computations for the final estimate.

During the construction of this work there were two very unusual storms, as noted on the report. These figures were obtained as noted from the Weather Bureau at Tthaca, N&Y.

Owing to the very heavy rainfall that occurred in May it was decided to install a waste pipe 36 inches in diameter in place of one of 20 inches. This was cast iron, asphalt coated and very carefully laid both as to line and grade. It was laid on a masonry wall with several cut off stops extending on each side and over the pipe, extra precaution being taken where the pipe crosses the puddle trench, the masonry extending down several feet to the rock as excavated in the trench.

At the time of the heavy rainfall that occurred from Sep 9 to 13, the top of the dam was at about elevation 315. The 36 inch pipe was 192 feet in length, the elevation at the lower end was ~~292x~~ 290.34 and at the upper end 296. The water rose above the dam

M. AM. SOC. C. E.  
(RESIGNED)  
E. J. Musson

Civil Engineer

OFFICE AND RESIDENCE 10 SHELTON ST.

NORWICH, N. Y.,

to the top thereof and I think overflowed a very little where a slight trench had been dug where less damage would doubtless resulted than would likely been done otherwise. Of course there was quite a large quantity of water impounded above the dam which ~~was~~ would materially reduce the rate of discharge over the waste weir at reservoir No. 1. I am not at all satisfied with such computations as I have made from the lower weir and of the 36 inch pipe, but the facts are as stated and I leave any further computations for you to take up if you so desire. As stated in the report, at the time of the latter storm the water in the reservoir No. 1 was 3 feet above the top of the weir at a point 50 or more feet back from the weir.

Mr. Sherman agrees with me as to the conditions at the dam at the time, except that he thinks the dam was about 30 feet above the pipe at the time, but as I have the original notes of construction at hand which show the elevation Sept. 12 as at 313 and Oct. 12 as 320, it would appear that 315 was about right.

Precipitation records have been kept by the writer for the past 16 years. Only twice during those years has there been a precipitation of over 3 inches in 24 hours, and in each case there has not been a discharge of 3 feet over the waste weir of res. No. 2, I should have stated that the water shed between the two reservoirs is probably less than 1/2 mile.

Trusting the information I have been able to furnish will meet your requirements, I remain  
very truly yours

*E. J. Musson*

Engineer for The Norwich  
Water Works

P.S.

We have a tracing of the entire area occupied by both reservoirs and adjacent territory as shown on the little map enclosed. This is drawn to a scale of 1 inch = 40 feet and if you desire I will send you a blue print. (We have no facilities for cloth prints)

ASSIGNMENTS' REPORT  
TO THE  
NEW YORK WATER POWER AND CONTROL BOARD  
ON THE  
NEW YORK WATER SERVICE CORPORATION  
FOR THE  
CITY OF NORWICH, NEW YORK

GENERAL AND HISTORICAL NOTES

The following description of the water supply system for the City of Norwich, New York has been compiled from information made available by the Company and the State Public Service Commission together with the results of various inspections in recent months by Arthur & Hecker. The data are mostly as at the date of July 1, 1946 and clearly show the property as of the present date since only minor work has been done since June, 1946.

The Norwich Water Works, so-called, was incorporated January 20, 1891. Plant construction was started early in 1891 and the first water service was given in January 1892. On November 16, 1926, the New York Water Service Corporation acquired the old company and changed the name to Norwich Water Service Corporation. On May 7, 1929 the system was merged into the New York Water Service Corporation, and is now commonly known as the Norwich Plant of that Corporation.

The Corporation furnishes water to domestic, commercial and industrial customers and gives fire protection by water service, in the City of Norwich and in parts of the Towns of Norwich, immediately adjacent to the easterly and westerly corporate limits of the City.

SOURCE OF SUPPLY

There are two sources of water. The first is about four square miles of drainage area along Mansford Creek in the Towns of Norwich, North Norwich and New Berlin, beginning about 1.5 miles northeast of the City of Norwich as will be seen from the accompanying U. S. Geological Survey topographic maps. In this drainage area are the two reservoirs first built, known as the "Upper" and "Lower". The Lower Reservoir has a surface area of about 6.6 acres, a maximum depth of about 30 ft. and a storage capacity of 32 million gallons, for 15 feet draw-down. Spillway elevation is 1188 feet above sea-level compared with about 1015 ft. for the center of the City. The Upper Reservoir is immediately upstream and has a surface area of about 9.1 acres, a maximum depth of 40 ft. and a storage capacity of 56.5 million gallons for a draw-down of 30 ft. The spillway here has an elevation of 1242 ft. or 54 ft. above the Lower Reservoir.

The second source of supply is Chenango Lake, in the Town of New Berlin about 3.5 miles northeast of the Lower Reservoir already mentioned.



The drainage area of Chenango Lake is contiguous to that of Rensselaer Creek and is about 0.6 square mile in extent. The lake surface is about 150 acres, and the normal elevation is 1750 ft. The drainage area has been developed to be contributory to the first area described, but it originally was part of the drainage area of Great Brook and the Unadilla River. Surface waters not used for domestic water supply still flow out to Great Brook. The Company, by purchasing the lands and water-rights of Chenango Lake and releasing upland cottage rights, has retained a strip of lake shore mostly 16.5 ft. wide. This strip is continuous around the lake except for a few interruptions totaling about 1900 ft. of shore, as shown on an appended map. The corporation obtained the right to raise the water level to a given height two feet above the prior normal level and to draw it down five feet below prior level. This gives a potential storage of 540,000,000 gallons when it can be utilized. The normal realized storage is from 200 to 250 million gallons. The old natural outlet at the south end of the lake was plugged, and an artificial spillway channel opened up at the north-east end into a different branch of Great Brook. To divert the lake water into Rensselaer Creek, a tunnel 761 ft. long was driven through the ridge separating the two basins and a pipe line of 14, 16 and 18 inch cast iron pipe was run another 9587 ft. to connect the lake and creek with the tunnel. Water from the lake runs 8,000 ft. in open brook channel to the Upper Reservoir already described.

#### OTHER LANDS

The Company owns about 270 acres of land around the reservoirs and Rensselaer Creek as shown in the accompanying map. This has been replanted with about 177,000 evergreen trees. To improve the appearance around the two reservoirs, about 3100 shrubs have been planted.

There is a tract of about 7 acres on the south side of the New Berlin Highway in the Town of Norwich just east of the Chenango River and the City of Norwich. Here is located the filtration plant. On the opposite bank of the river, in the City of Norwich, is a corresponding tract of about 10 acres held undeveloped.

The Chenango Lake Tunnel and the approach pipe lines are under a strip of land 50 ft. wide owned in fee. The balance of the lake to creek line is on easements. The Company owns easements to extend the lake delivery line through to the Upper Reservoir and has rights to the waters of Rensselaer Creek.

There is a private right of way about 4700 ft. long for two 12-inch cast-iron transmission mains leading down from the Lower Reservoir. This parallels the New Berlin highway. The two mains continue under the highway for another 1200 ft. to the filtration plant just outside the City as already noted. From the filtration plant, one 12-inch cast-iron main runs mostly under public ways into the Town and City of Norwich to River and Rensselaer Streets where it becomes a part of the distribution grid. A 10-inch cast-iron delivery line also runs on private lands about 1200 ft. from the filtration plant to River and to Rensselaer where it joins the distribution system. All river crossings are on private lands.

The distribution system is laid almost entirely under public streets. There is a length of about 350 ft. on a private alignment near Broad and American Streets. South of the D.E. & T. L.R. at Front and Thompson Streets is a 600 ft. stretch. Near Main and Beebe Streets are two lengths aggregating about 500 ft. From the end of East Main Street is a stretch on private right of way to River Road across the Chenango River.

#### STORAGE FACILITIES

Lower Reservoir. The dam at the Lower Reservoir was built in 1881. It is an earth embankment with puddled core. The maximum height is 39.3 ft. and the length is 240 ft. The top width is 12 ft. The upstream slope is 2.5 to 1 with a broken stone paving; and the downstream slope is 2 to 1 with a seeded soil top. The spillway is flanked by a concrete and masonry weir, or overflow section, 45 ft. long between two wing walls of stone and concrete masonry 4.5 ft. wide, 2.3 ft. high and 45 ft. long. The spillway discharges into the old creek channel. The spillway approach and apron are paved with heavy stone. The intake at this reservoir is a 24-inch cast-iron stand pipe with three 12-inch intake gates at different levels, all enclosed in a masonry tower. A "rind pipe," or drain, of 16-inch cast-iron pipe, 230 ft. long extends through the bottom of the dam and terminates in a dry masonry head-wall at the outlet end.

Upper Reservoir. The dam at the Upper Reservoir was built in 1891; it is an earth embankment with puddled core, 612 ft. long with a maximum height of 50.5 ft. and a top width of 18.5 ft. The upstream slope is 2.5 to 1 with 18 inches thickness of stone rip-rap. The downstream slope is 2 to 1 with seeded soil top. The spillway is a concrete weir, or overflow section, 45 ft. long between wing walls, 2.5 ft. wide, 2.5 ft. high and 48 ft. long. The spillway has a cut-off wall extending 7 to 12 ft. below the flow line. The side walls extend 5.6 to 7.1 ft. below the flow line. The spillway approach channel and downstream apron are paved with heavy stone. This spillway discharges into a by-pass channel which has been dug past both reservoirs and empties into the old creek bed.

In 1914, counterweighted flashboard were installed on the spillway of the Upper Reservoir dam so as to raise the water level 2.5 ft. These boards are of 2" by 8" plank built in two sections. They are lifted by four hand wheels working through racks and pinions from a bridge above the spillway. This bridge is formed by two 8" I-beams with a 4" yellow-pine floor.

The upper intake is a 14-inch cast-iron pipe with a copper mesh screen, protected by a masonry chamber which is topped with a frame structure and connected to the dam by a 68 ft. steel bridge with wood floor. A 20 to 36-inch cast-iron "rind pipe," or drain, 232 ft. long, runs under the bottom of the dam from a influent chamber (this chamber is 7 x 7 x 4 ft. with a top grill of 3/4 inch iron bars) to the outlet and is protected by a 2 x 4 ft. masonry wall.

A 12-inch cast-iron by-pass line about 2,000 ft. long extends from the 36-inch outlet pipe of the Upper Reservoir below the dam, along the south side of the Lower Reservoir and connects into the two 12-inch transmission lines leading to the City. At a point about 150 ft. upstream from the lower dam is a 12-inch cast-iron pipe lateral leading to 15 jet aerator nozzle. Normally water from the Upper Reservoir is discharged through this jet into the Lower Reservoir.

A caretaker's two story frame house on rubble stone foundations is located opposite the Upper Reservoir. Adjacent to it is a one-story frame barn and a one-story garage.

Chenango Lake. The outlet dam at Chenango Lake is a block of concrete and masonry across an open cut previously made to supply a mill. Through the block is a 24-inch sleeve with sluice-gate and floor stand. Over this is a timber cover and around it is a steel-wire mesh fence, 7 ft. high. The Chenango Lake outlet consists of a 10 ft. riser of 14-inch cast-iron pipe, topped with a copper basket screen, 6 ft. high. The outflow is controlled on the shore by a 14-inch gate valve in box.

#### ADEQUACY OF SUPPLY

The Company records show conclusively that over periods of time aggregating several years, the described sources (exclusive of the use of Chenango River water which was used for a short time as an emergency supply) have supplied an average of 2 million gallons per day or more. (In the earlier days the consumption was excessive due to general lack of customers' meters and to the use of inadequately regulated sewer flush tanks.) The supply of 2 million gallons per day or more was maintained in spite of the fact that storage on Mansford Creek amounts to only about 90 million gallons, or 25 million per square mile of drainage area, which is rather low.

However, we have investigated a dam and reservoir site on the south branch of Mansford Creek above the Upper Reservoir. The drainage area is approximately 2 sq. mile, and there appear to be many springs in the area. At a point about 1400 ft. above the present Upper Reservoir dam can be constructed to impound 150 to 200 million gallons of water. With this development, it is estimated that the present sources of supply, as enumerated, will be able to supply an increased consumption at least as great as can be foreseen for a long time in the future.

#### PURIFICATION WORKS

Filtration Plant. From 1882 to 1905 the supply of water was delivered to customers without purification or treatment. In the latter year, the Company installed four horizontal-tank rapid-sand pressure filters, at the site which has been described as south of New Berlin highway adjacent to the Chenango River and the City. Two additional horizontal-tank rapid-sand pressure filters were added in 1907. The pressure tanks are 8' in diameter by 40' long. The filters were made by the New York Continental Jewell Filtration Company and each contains 8 cu. yds. of gravel with 16 cu. yds. of filter sand. The

The secondary buildings at the filtration plant site include the following: (1) Storage barn; 1 story frame structure with ridge roof and gable ends, clap board sides, ruberoid roofing, on 2" sheeting. One barn section is 30 by 24 ft. and 20 ft. high to roof peak; a second section is 30 by 16.2 ft. and 17.5 ft. high; a third section is 16 by 16.2 ft. and 14.5 ft. high. (2) Sand Storage Bin; a Ship-lap bin 9 by 20 ft. by 6.3 ft. with ruberoid roof, painted outside. (3) Hydrant & Hose House; 1 story frame structure 6 by 3 by 6.3 ft. and 9 ft. high to roof peak. Has concrete foundation, ruberoid roof and batten door; contains a 6" hydrant with 2 hose nozzles and steamer connections, and 350 ft. of 2-1/2" fire hose and nozzle. (4) There is a gravel drive, 12 ft. wide into the grounds and around the rear. There is 1300 ft. of 3-strand wire fencing on wood posts.

Chemical House at Lower Reservoir. On the south side of the Lower Reservoir near the dam is a chemical feed house. This is a hollow tile building, 16.3 by 24.3 ft. and 14 ft. high to roof peak. The foundation is of concrete and the building has a basement. The roof is of wood frame with asphalt shingles. The house is heated by a cast-iron boiler and 7 wall type radiators. There are 6 electric outlets. There is located here a Wallace & Tiernan automatic chlorinator, Type 'LH8', with 1" copper delivery piping to the main outlet, and a 500 lb. platform scale. There is also a Wallace & Tiernan dry-feed alum machine driven by a 15-inch water wheel. A chemical feed line of 4-inch cast-iron pipe leads to the outlet below the lower dam.

Farm Drainage Purification. To meet the requirements of the State Department of Health and to prevent farm sewage on the Ramond Creek drainage area from getting into the collected waters, the County has built and maintains on the Polletts, Bixby, Hudson, Skinner, Tooly and Anderson farms, steel septic tanks 38 by 46-ins. each with asphalt cover and an average of 75 ft. of 4-in. tile drain.

#### MAINS, SERVICES, PIPES, FITTINGS

Transmission Mains. The transmission mains, as so classified by the Company, are shown in the following list, at July 1, 1945.

18" Pit-Cast Iron Pipe	784	L. Ft.
16" " " " "	1734	"
14" " " " "	7002	"
12" Wrought Iron tar coated	137	"
12" Pit-Cast Iron Pipe	13106	"
10" Bell & Pocket Cast Iron Pipe	480	"
10" Pit-Cast Iron Pipe	433	"
8" Centrifugal Cast Iron Pipe	14	"
6" Pit-Cast Iron Pipe	15	"
6" Centrifugal Cast Iron Pipe	50	"
Total length	26735	"

The following are facts developed by the State Engineer  
to the properties owned by the Village of Norwich.

1881 - Norwich Water Works incorporated January 31, 1881.  
Board of Trustees of the Village of Norwich granted a  
Franchise to lay and construct necessary pipe in and  
along village streets.  
Water Company purchased lands along Ransford Creek to  
build and impound waters of this creek, and contract  
let for building Reservoir No. 1 (Lower) holding about  
30,000,000 gallons, and for laying 12" transmission  
main to Rexford and Silver Streets. The original contract  
and the Franchise are on file in the Water Office. The  
record shows that approximately 3,800 feet of this  
1881 line were laid in the highway (State Route 23).  
All riparian rights in the waters of Ransford Creek  
from the reservoir location to the Chenango River and  
necessary rights of way for the 12" line were also pur-  
chased. A record of these purchases and the deeds are  
also on file in the Water Office.

1890  
1891

Additional lands east of Reservoir No. 1 purchased and  
Reservoir No. 2 (Upper) constructed to hold approximately  
60,000,000 gallons. Original contract on file in the  
Water Office. Both dams have puddled cores (clay) and  
working drawings of both are on file in the Water Office.  
A 12" line is laid from the 36" waste line of the Upper  
Reservoir, around the south side of the lower Reservoir  
from which 14" and 36" inlets can be taken.  
The lower Reservoir together with 16" line

1904 - A second 12" transmission main was constructed to the Village, and this line is interconnected with the first 12" (1881) line so that the city supply can be delivered from either reservoir or both. This new line was reduced to 10" west of the Filter Plant and was laid under the river (as was the 1881 line) and up Gold Street to Silver.

1900 - The Norwich Water Works paid Colonel Edwin Loomis the sum of \$15,000.00 to raise the level of Chenango Lake and draw down the waters thereof a maximum of 7'. Contract let to lay intake pipe and outlet line (including 750' of 4' rockcut tunnel) in Towns of New Berlin and North Scituate to the headwaters of Hansford Creek. Rights were also purchased from other lake front owners to raise lake level and rights of way to lay outlet line.

1919 - Sale (on mortgage foreclosure) by National Bank & Trust Co. of Norwich to the Norwich Water Works of all the lands in Town of New Berlin owned by late Colonel Loomis including approximately 111 acres of the 135 acres total surface of Chenango Lake.

The standing timber on the Loomis Lands sold to Bell State Cottage lots surveyed and mapped on east, south and west sides of lake.

1905  
1905

Filter Plant land purchased in 1904 and Filter Plant built with four units installed in 1905 and 1906. The plant has a filtering capacity of 500,000 gallons per day. The chemical treatment began using solution of alumina and lime for clarifying and hypochlorite of lime solution for purifying. Operation with laboratory control under the supervision of

PREVIOUS INSPECTION REPORTS

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION  
DAM INSPECTION REPORT  
(By Visual Inspection)

10-14 Ros 72

<u>Dam Number</u>	<u>River Basin</u>	<u>Town</u>	<u>County</u>	<u>Hazard Class*</u>	<u>Date &amp; Inspector</u>
621	Saug	Norwich	Chenango	B +	11/14/75 RDH GUE

Type of Construction

- ☒ Earth w/concrete spillway  
☐ Earth w/drop inlet pipe  
☐ Earth w/stone or riprap spillway  
☐ Concrete  
☐ Stone  
☐ Timber

Use

- ☒ Water Supply  
☐ Power  
☐ Recreation  
☐ Fish and Wildlife  
☐ Farm Pond  
☐ No Apparent Use-Abandoned

Estimated Impoundment Size

- ☐ 1-5 acres  
☒ 5-10 acres  
☐ Over 10 acres

Estimated Height of Dam above Streambed

- ☐ Under 10 feet  
☐ 10-25 feet  
☒ Over 25 feet

Condition of Spillway

- ☒ Service satisfactory  
☐ In need of repair or maintenance  
☒ Auxiliary satisfactory  
☐ In need of repair or maintenance

Explain: \_\_\_\_\_

Condition of Non-Overflow Section

- ☒ Satisfactory  
☐ In need of repair or maintenance Explain: \_\_\_\_\_

Condition of Mechanical Equipment

- ☒ Satisfactory  
☐ In need of repair or maintenance Explain: \_\_\_\_\_

Evaluation (From Visual Inspection)

- ☒ No defects observed beyond normal maintenance  
☐ Repairs required beyond normal maintenance

\*Explain Hazard Class, if Necessary \_\_\_\_\_



APPENDIX E

REFERENCES

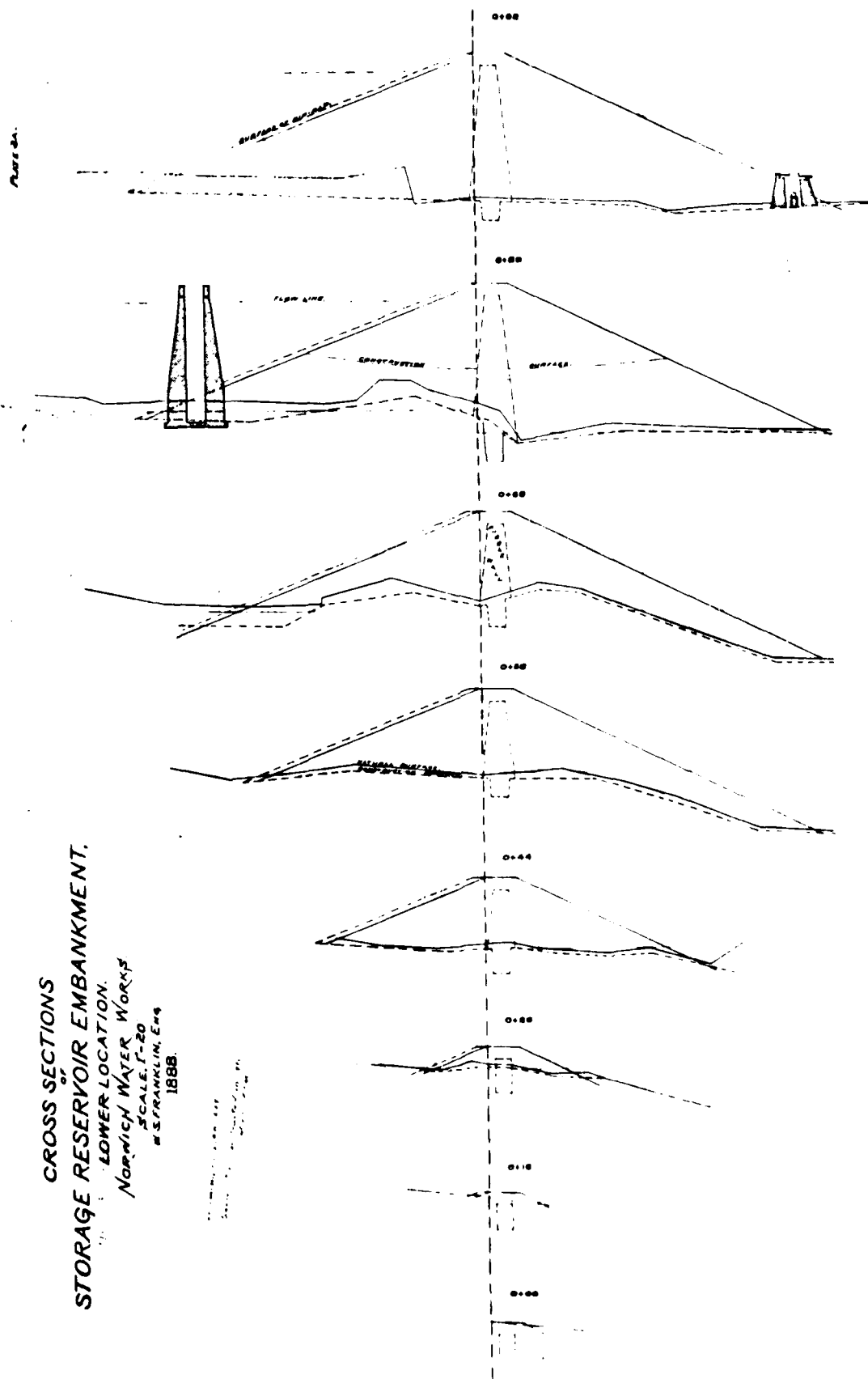
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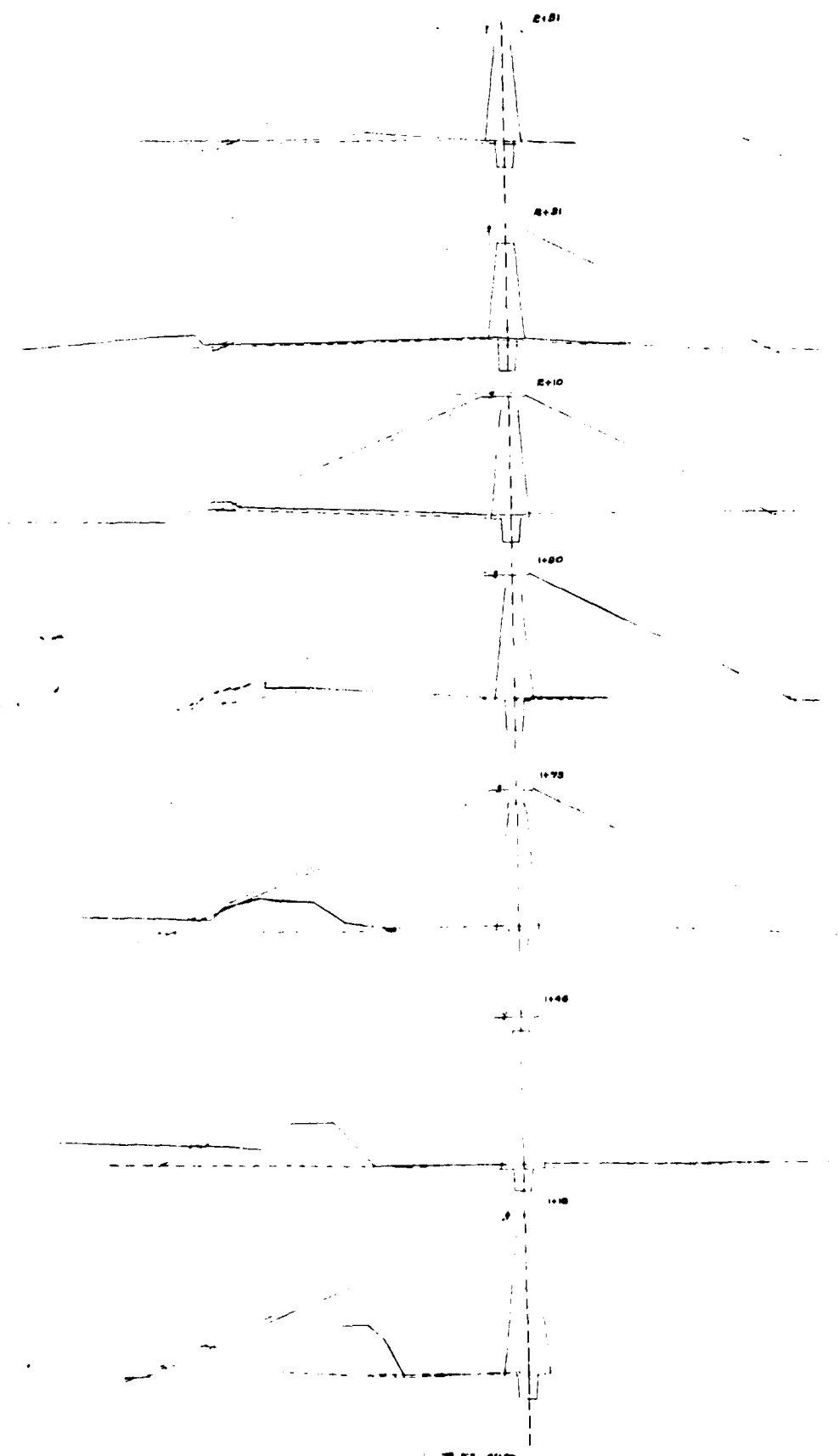
APPENDIX F

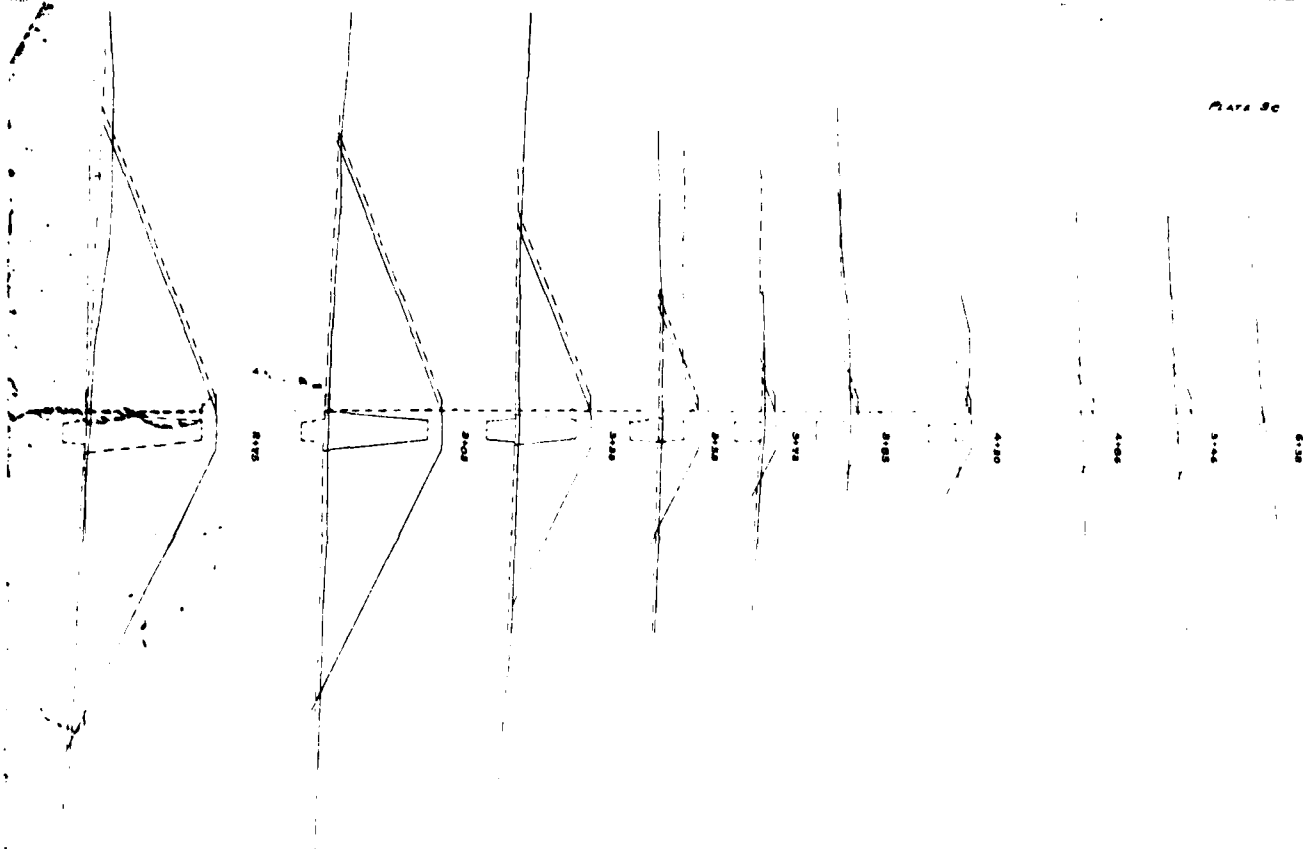
DRAWINGS

CROSS SECTIONS  
 STORAGE RESERVOIR EMBANKMENT.  
 LOWER LOCATION.  
 NORRICH WATER WORKS  
 SCALE, 1"=20'  
 W.S. FRANKLIN, E+9  
 1888.



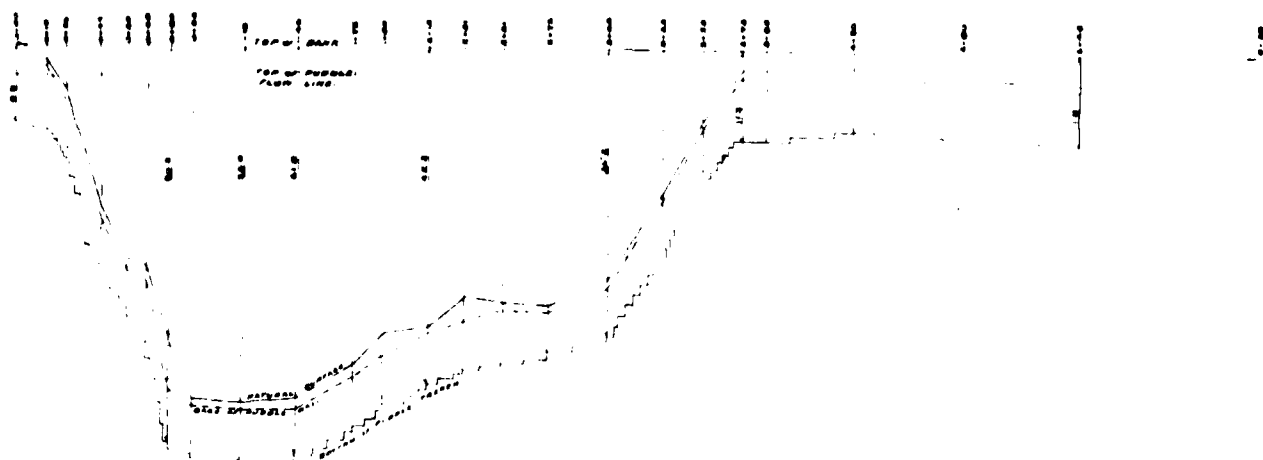
1. *Chlorophyll* *a* and *b* content of leaves was determined by the method of Arar and Johnson (1977).

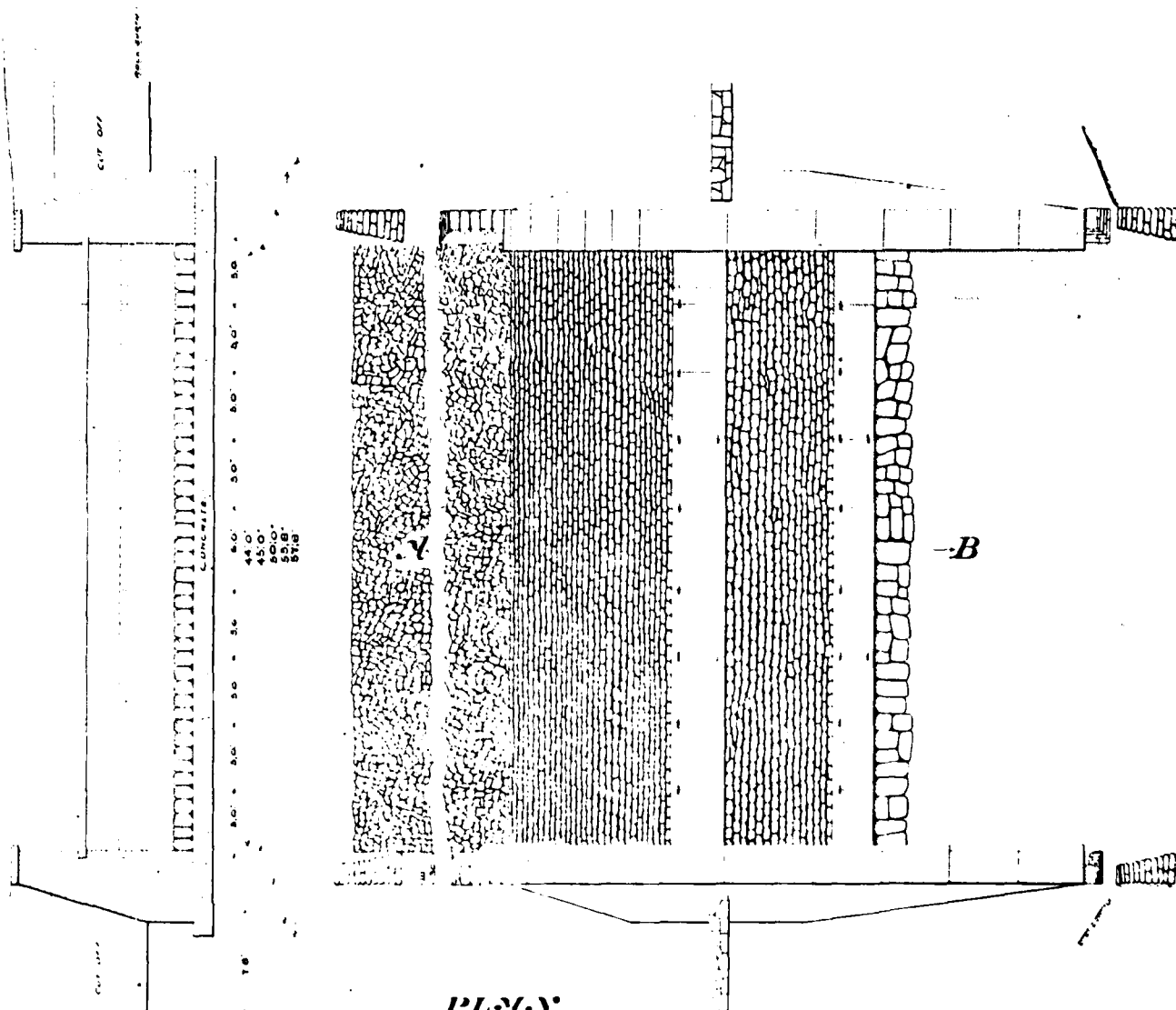




PROFILE

NOT SCALE 1:10  
1:10





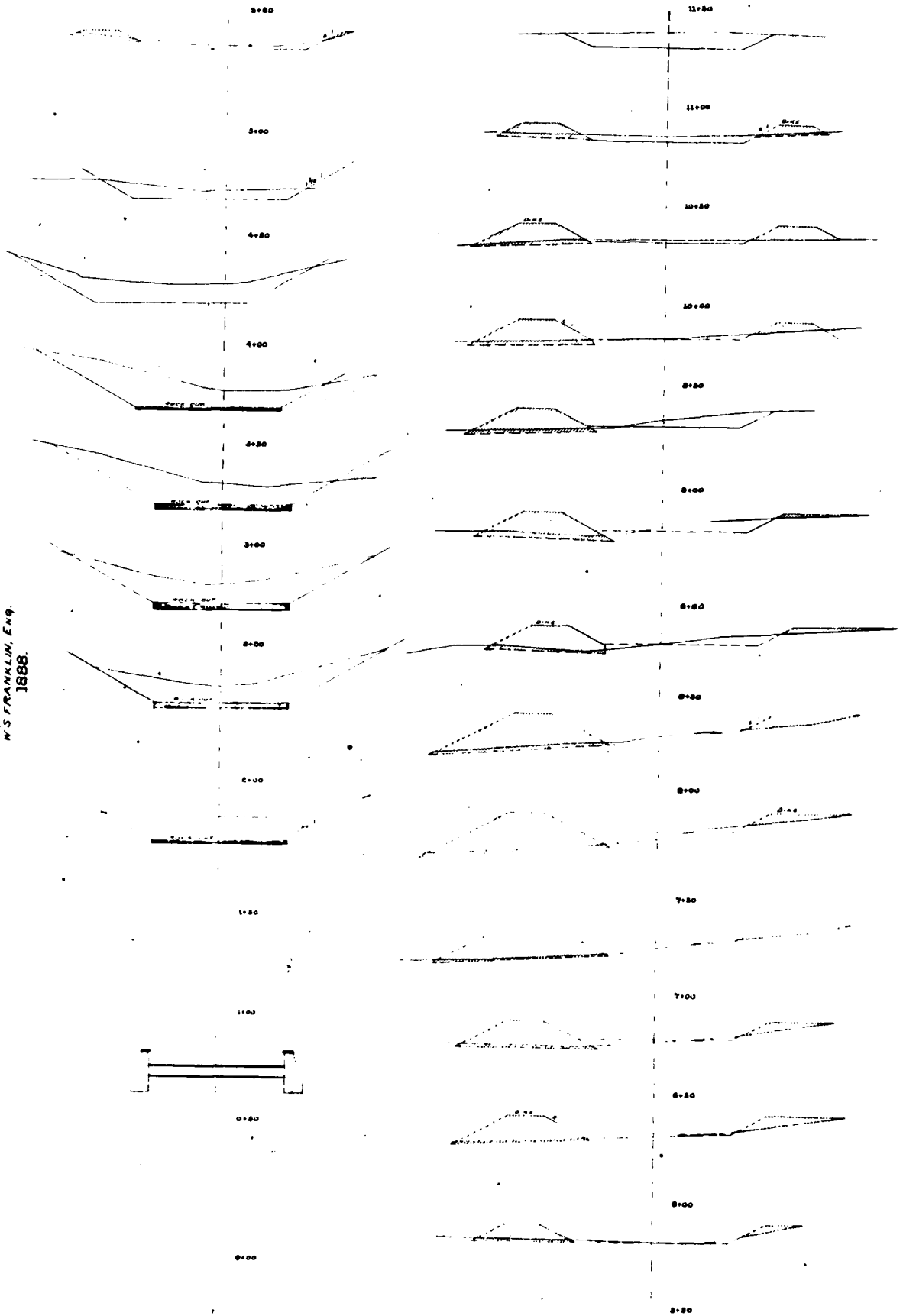
PLAN  
OF  
WASTE WEIR  
NORWICH WATER WORKS  
SCALE: 1/4" = 1'  
W. FRANKLIN, ENG.  
1888

APPARENT SURFACE OF ROCK

SECTION ON LINE "A-B"

PLATE 2A.

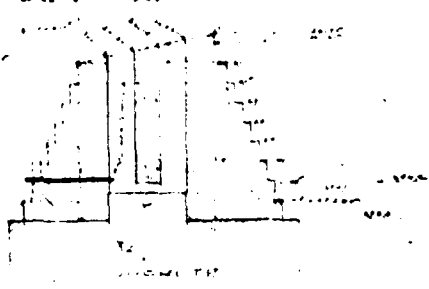
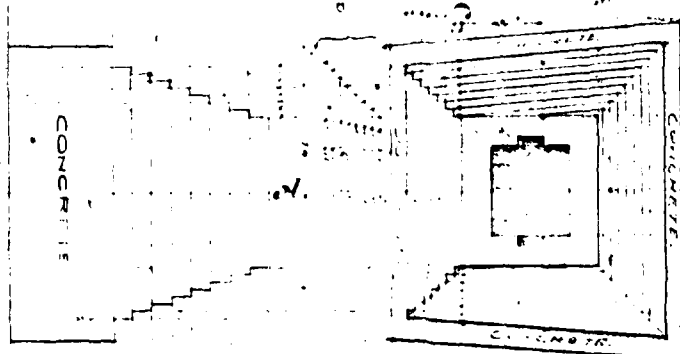
CROSS SECTIONS  
OF  
BY-PASS CANAL.  
NORWICH WATER WORKS.  
SCALE, 1"=40'.  
W.S. FRANKLIN, ENG.  
1888.





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24:00	24:00	24:00

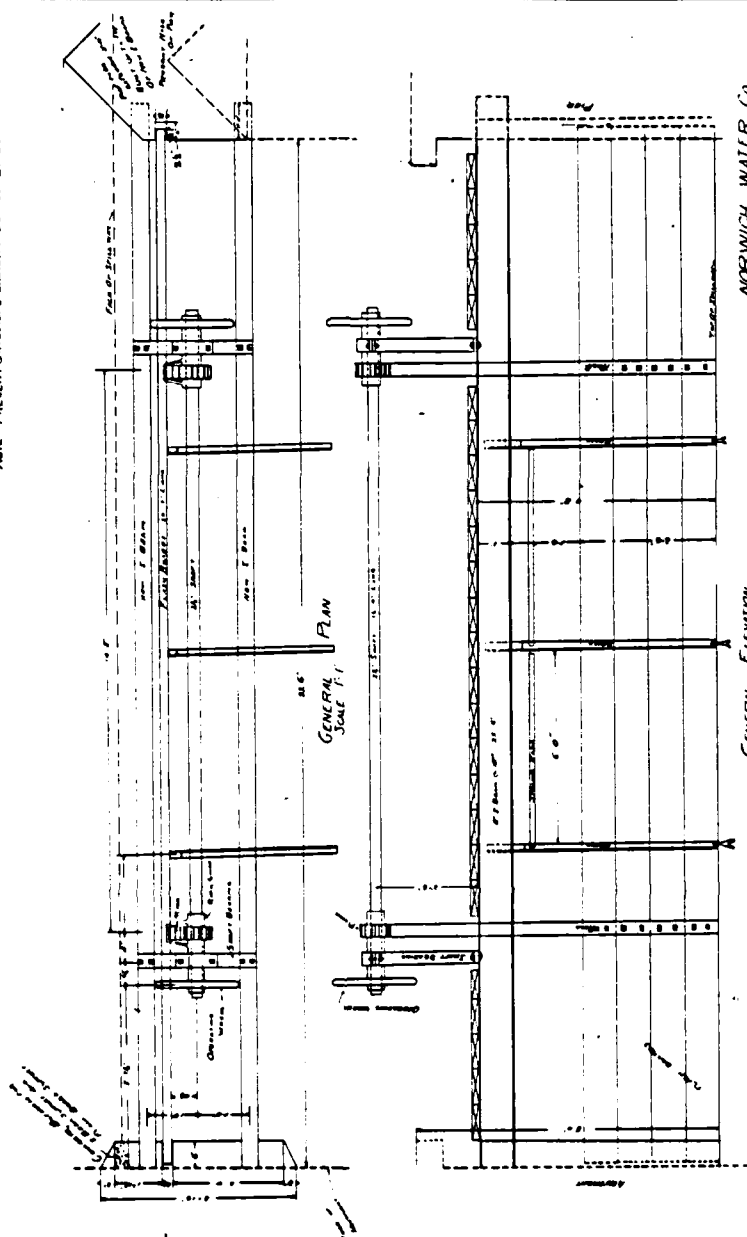
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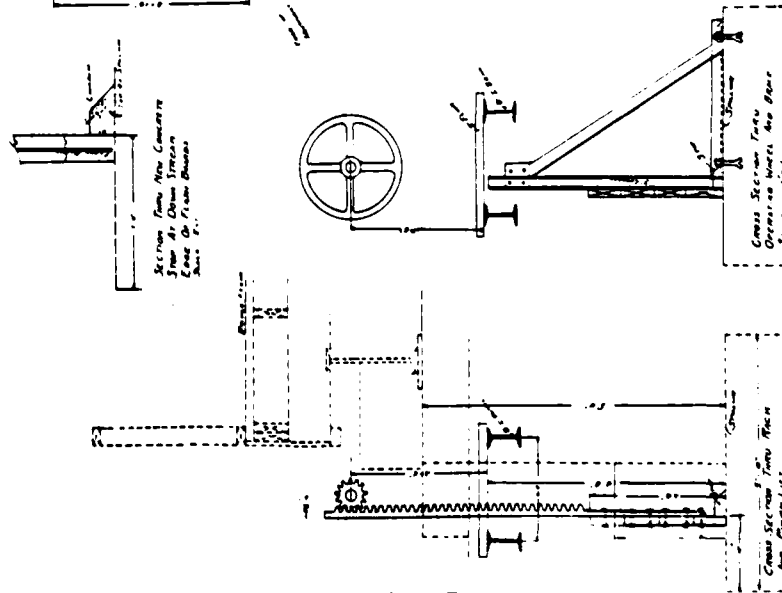
SECTION  
A-B

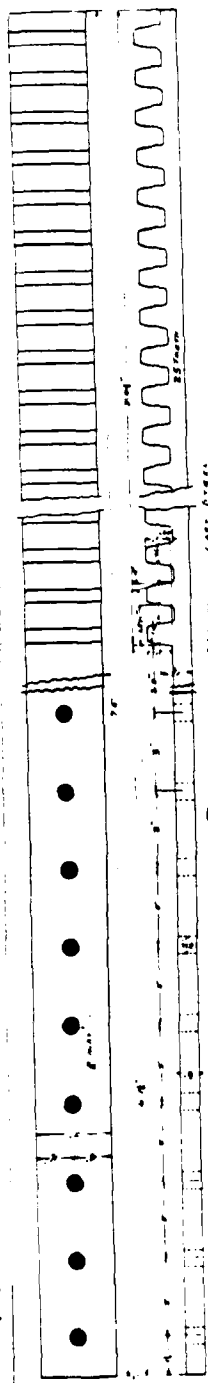


NOTE: PRESENT STRUCTURE SHOWN IN DOTTED LINES

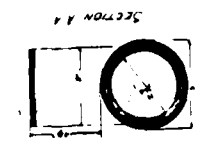
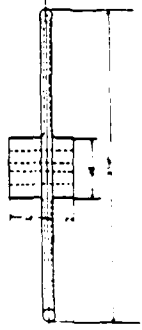
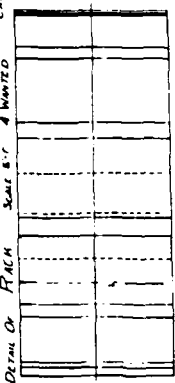


NORWICH WATER CO  
NORWICH, N.Y.  
MOVABLE FLASH BOARDS  
FOR  
BY PASS CANAL  
GENERAL PLANS  
JULY 20 1910  
G. D. MORRIS  
CIVIL ENGINEER

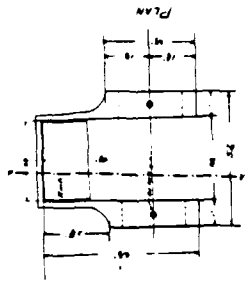




DETAIL OF RACK SCALE 1/4" = 1" WANTED



SECTION A-A

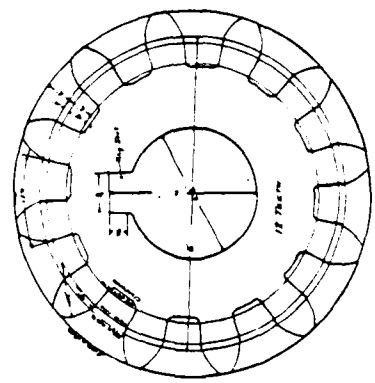


DETAIL OF RACK GUIDE SCALE 1/4" = 1" WANTED

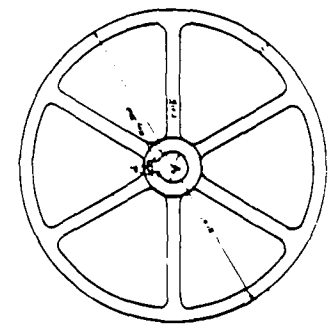
NORWICH WATER CO  
NORWICH, N.Y.  
MOVABLE FLASH BOARDS

BY: BASS SABEL  
DETAILS OF  
OPERATING WHEEL  
SHAFT BEARING  
RACK GUIDE  
RACK  
SHAFT GEAR

4614 88 112 C.E. NORRIS  
Chief Engineer



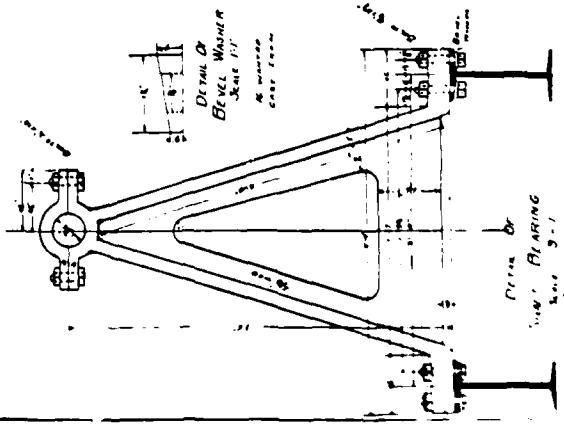
DETAIL OF SHAFT GEAR SCALE 1/4" = 1" WANTED



DETAIL OF WHEEL OPERATING WHEEL SCALE 1/4" = 1" WANTED



DETAIL OF BEVEL WASHER SCALE 1/4" = 1" WANTED



DETAIL OF SHAFT BEARING SCALE 1/4" = 1" WANTED

AD-A107 414

FLAHERTY-GIAVARA ASSOCIATES NEW HAVEN CT  
NATIONAL DAM SAFETY PROGRAM. NORWICH RESERVOIR NUMBER 2 DAM (IN--ETC(U)  
AUG 81 H C FLAHERTY

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DACW51-81-C-0006

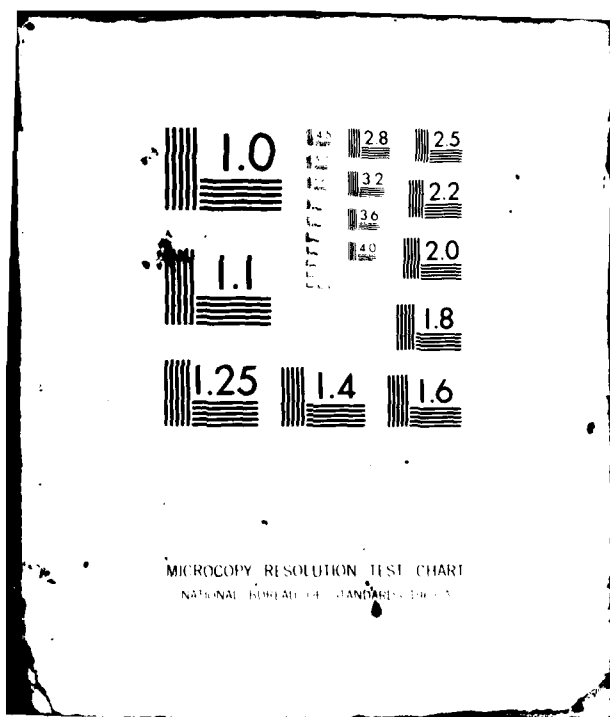
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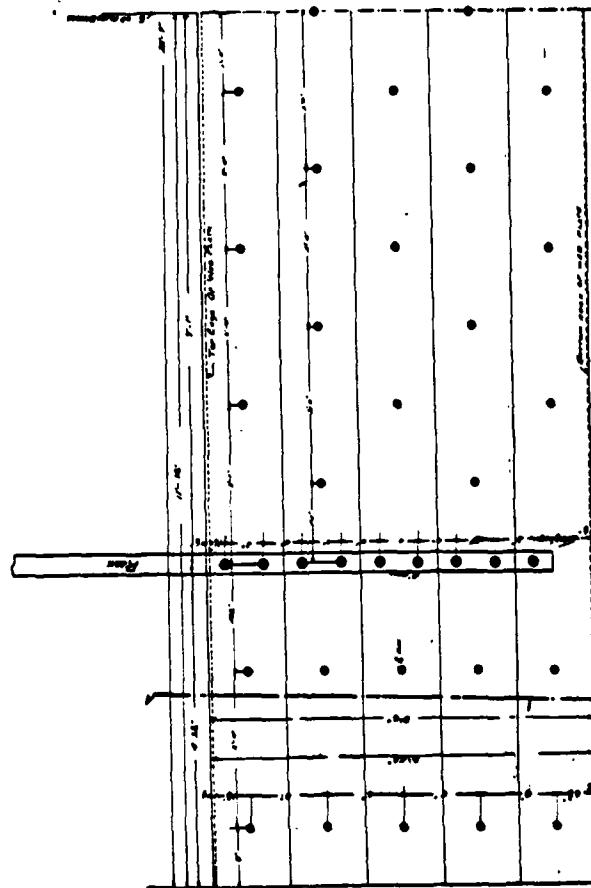
UNCLASSIFIED

3 x 3  
4 1/2 x 1 1/2

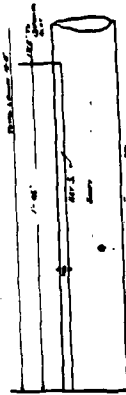


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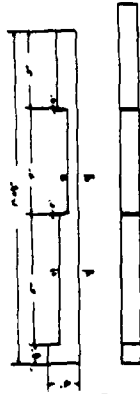




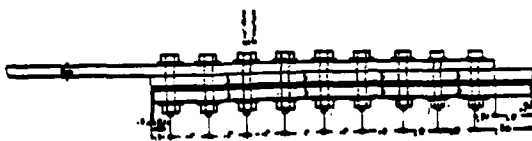
DETAIL OF  
FLASH BOARD  
Scale 1/2" = 1'



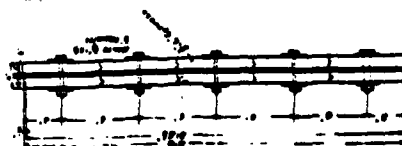
DETAIL OF  
SHEET  
2 WELDED  
ANCHOR STEEL



DETAIL OF  
SHEET KEY  
2 WELDED  
ANCHOR STEEL



SECTION A-A



SECTION B-B

NORWICH WATER CO  
NORWICH, N.Y.  
MOVABLE FLASH BOARDS

FOR  
BY FRANK CANNAL  
DETAILS OF  
FLASH BOARDS  
SHEET  
NET

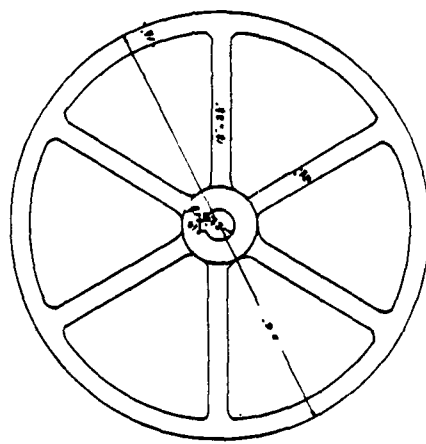
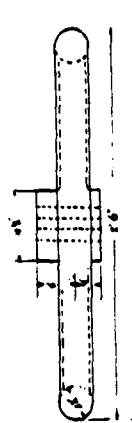
July 28, 1904  
W. E. Morris, Engineer  
NEW YORK



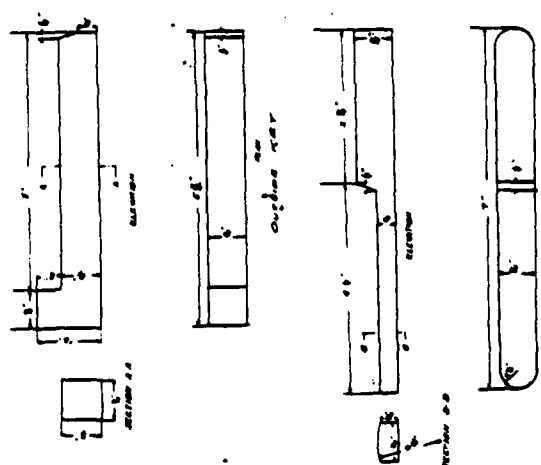
NORWICH WATER CO  
NORWICH N.Y.  
MOVABLE FLASH BOARDS  
FOR  
BY PASS CANAL  
DETAILS OF  
1 BEAMS  
BRACES

July 20 1910  
C E Harris  
Genl Engineer  
SHEET No 4





DETAIL OF  
OPERATING WHEEL  
FOR GATE  
CAST IRON



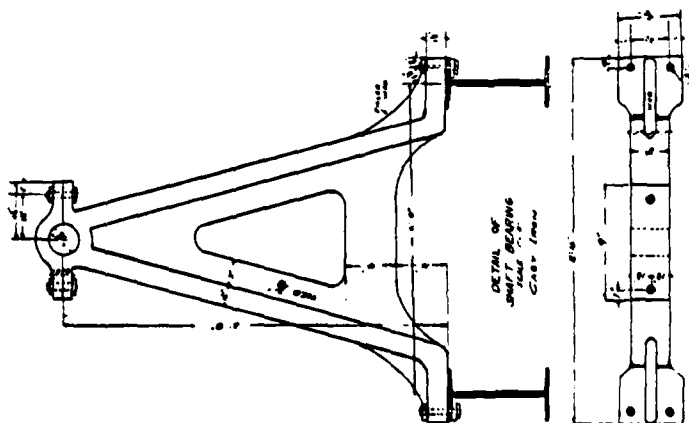
DETAIL OF KEY  
FOR GATE  
FORGED STEEL

NORWICH WATER CO  
NORWICH N Y  
MOVABLE FLASH BOARDS  
FOR  
BY PASS CANAL  
DETAIL OF REPAIRS

July 14, 1914

C. E. HARRIS  
Civil Engineer

Sheet No. 2



DETAIL OF  
UPPER BRACKET  
FOR GATE  
CAST IRON

Top View

DATE  
FILMED

— 8